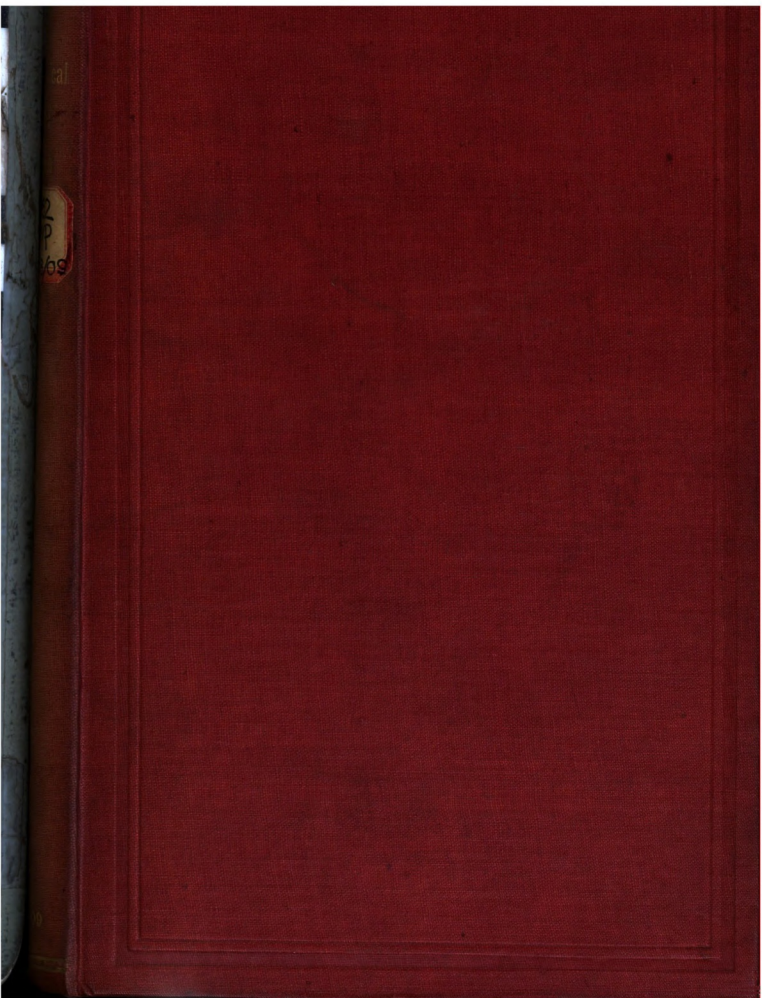




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PROCEEDINGS
OF THE
ROYAL PHILOSOPHICAL SOCIETY
OF GLASGOW.

SESSION 1908-1909.

Address by FREELAND FERGUS, M.D., F.F.P.S.G., F.R.S.E.,
President, delivered before the Society on 4th November,
1908, at the opening of Session 1908-1909.

PART I.—*Present Position and Prospects of the Royal Philosophical
Society of Glasgow.*

GENTLEMEN,—When you did me the honour to elect me to the
Presidentship of this Society I felt that you had relieved me of
a considerable burden. After all, the success or failure of any
society depends perhaps more on its Secretary than on any of its
other officials. For eleven years I discharged, in some fashion,
the duties of the Honorary Secretaryship, and I think it right here
and now to say that any success which attended my efforts on
behalf of the Society was largely due to the zeal, to the efficiency,
and to the intelligence with which the duties of the Acting Secre-
tary were discharged by Mr Angus M'Lean now Principal of the
Technical College, Paisley, and more recently by our esteemed
friend Professor Peter Bennett. When I took up the Honorary
Secretaryship it was merely as a stop-gap, an arrangement to last for
only a few months, a post which I was willing to fill for a short time
as a sort of act of filial piety, for I remembered with gratitude how
singularly this Society had honoured and trusted my late father.
Little did I realise that for 11 years I would be actively engaged
as Honorary Secretary in the administration of its affairs, and that,
with a generosity of which I confess I am not worthy, you would
reward my labours by electing me your President.

Some of the recollections of my early boyhood are connected
with this Society. So far back as the year 1871 I attended its
meetings, for at that time my father took an active part in its
affairs, and after school hours I was often employed in carrying
along books and manuscripts and various munitions of war to
help him in the fray. I remember well in these days Sir William
Thomson and Professor Grant as Presidents, and Mr William

Keddie as Secretary. The few members of the Society who have been connected with it long enough to remember Mr Keddie will, I am sure, agree with me when I say that it is almost impossible to imagine any one better fitted for the post than he. A most modest and retiring man, in his own line of life he was profoundly erudite, and he was held in high esteem by all who had the privilege to know him. It is no easy task to occupy the Chair of a society which has such an honourable history and such traditions, nor is the burden lessened by the thought that this year we reach another important epoch in the Society's career. We have come, as it were, to the parting of the ways. We now no longer occupy premises conjointly with our friends the Institution of Engineers and Shipbuilders in Scotland, and henceforward new responsibilities, chiefly financial, will have to be undertaken by the Society, which I trust it will be well able to meet. I sincerely hope that the future of the Society will be as prosperous and as successful as the past, and that it will continue, for many years to come, to do useful work in the city of Glasgow. That, however, depends upon the members of the Society, upon their co-operation with those whom they appoint from time to time to its board of management, but I feel sure that if there is a hearty and cordial effort made generally by the members to promote the great ends for which it exists that there will be an advance and not a retrogression.

Undoubtedly there have been considerable changes, even within my own recollection. These were perhaps inevitable, but they have considerably altered the character of the Society, and changed its scope of operations. It was called into being for the study of the mathematical and physical sciences, and for the study of the practical application of physics and chemistry to the arts and manufactures. It had a definite aim and that was, the propagation of technical knowledge amongst its members. It was for many a day, in a very special sense, the meeting place where men of scholarship in these departments of knowledge were brought into contact with their practical brethren. In recent years the scope of the Society's work has been much expanded. Technical societies have grown up all round. In the old days if a man discovered something new in mechanics, the science of machines, there was practically no other place at which he could exhibit his invention in Glasgow than at one of our meetings. In the same way, if an industrious man had invented some new process in dye

ing or in bleaching the likelihood was that he would also communicate it to the Philosophical Society. It was, in those days, a Society consisting almost entirely of members who worked and who brought the results of their researches before the notice of their fellow members. The growth of technical societies has somewhat deprived us of such contributions, and that, personally, I very much regret. It ought still to be a place where communications are made in all departments of scientific knowledge by workers. It should, in a very special manner, be the place where gentlemen engaged in various departments of scientific work should meet each other and interchange their views, and, further, it ought to be the point of contact between the scholars and students of our city and the ordinary every-day man in the street. I, for one, see no reason why a great deal of work done in Glasgow should be communicated to the scientific world in other towns, unless it be that there is a prevalent idea that technical scientific communications are no longer acceptable at the Royal Philosophical Society of Glasgow. If that idea exist it is a totally erroneous one, for the reception of such communications is still, to me, one of the chief objects for which this Society exists. In past years the community of Glasgow has derived much advantage from the frequency with which members of the staff of the University and of the staff of the old Andersonian made contributions to our *Proceedings*. I earnestly trust that as in the past, so in the future, the gentlemen who are connected with the learned institutions of the city will take a keen interest in our work, and will communicate to us from their stores of knowledge. Personally, I do not view altogether favourably the modern tendency, a tendency against which I ineffectively struggled for the 11 years during which I held the office of Secretary, to turn the Society into an institution chiefly for the hearing of lectures. To my mind a lecture Society is not one of very great or essential benefit to its members. No doubt, in the audience at a popular lecture, there may be some whose intellectual life is awakened, to whom new thoughts are suggested, and to whom new vistas are opened up; but not infrequently those who attend popular lectures simply have their ears tickled by matters which to them are new and of passing interest, but which exercise no permanent incentive to work, and which generally are entirely forgotten shortly after the delivery of the lecture.

Personally I would like to see this Society much more used for short practical communications than it has been for some time. I am well aware that technical work now-a-days must very largely go to technical societies. I have no wish to take a limited view of the matter. Undoubtedly it has strengthened our Society enormously to have such sections as the Historical and Philological section and the Economic Science section. Much valuable work has been done in both of these, and at their meetings gentlemen with expert knowledge have freely contributed their information to those engaged in similar studies. A society like ours must be whatever its members make it, and I trust that even a larger number of its members will take part in our proceedings than in past years.

Three or four short communications every evening of a practical and original kind would, I think, be of great value to the members.

The reading *in extenso* of long papers taking from an hour to an hour and a half to communicate seems to me to be for the most part a mistake. At the same time if a member has brought together a large amount of valuable information on a subject on which he can speak authoritatively, I for one, would be very loth in any way to muzzle him or to prevent the Society deriving full benefit from his labours. A communication dealing exhaustively, although not exhaustingly, with a subject can quite well be printed in full, although only communicated in summary. No hard and fast line can be laid down, and perhaps it is better that authors be left very much to their own discretion in a matter of this kind.

At one period I hoped that there might be a union of incorporation between the Royal Philosophical Society and some of the others such as the Geological and the Natural History Societies, so that there might be one great and strong centre of scientific work in the city of Glasgow. If it can be shown that in this particular case union would make strength then the idea might be reasonably entertained. As matters stand at present, there is a certain amount of over-lapping. The members of one Society do not know what those of the others are doing, and even in such a matter as the formation of Libraries, copies of the same book are often to be found in the Library of each of these Societies, all housed in the same building.

Were some scheme of union possible it might strengthen materially the position of scientific research in our community.

At the same time, were such a union in any way to interfere with or prejudice the excellent work which has been done by such societies as those I have mentioned, it would simply be a disaster. They have done admirably in their own departments, and any limitation of their usefulness is much to be deprecated. Before I conclude this part of my address, may I say that we wish the Society of Engineers and Shipbuilders in Scotland all possible success in their new undertaking. Glasgow and the Clyde Valley is in a very special manner the calf country of marine engineering, and such an Association should be, and no doubt is, one of the most important in the world alike in the scientific work which it produces and in the strength of its membership. We rejoice at their success and we wish them all prosperity.

PART II.—*Bishop Berkeley and his New Theory of Vision.*

THE theory of vision is a subject which has attracted the attention of the learned from time immemorial. Thus, to go no farther back, we find that Isaac Newton wrote on the subject, so also did Descartes, Thomas Young, Clerk Maxwell. In more recent times, Helmholtz has contributed two volumes of considerable size on the subject which must for many generations be accounted a classical work. No doubt some of the views enunciated by him have been slightly modified, yet certainly he, more than anyone else, established modern theories as regards the refraction of the eye and as regards the function of accommodation. The scientific side of all modern ophthalmic practice, in so far as it concerns physical notions, is at this moment based almost entirely on the work of Helmholtz. He it was who massed together the scattered fragments of less illustrious workers, pieced them together, and has added to the structure the products of his own transcendent genius. The theory of vision is essentially connected with the study of light, and so it is not surprising that physicists in all generations have been occupied with the investigation of luminous sensations. Metaphysicians, too, have had their say on the matter, and recently, being the happy possessor of a little leisure, I looked up and read Berkeley's Theory of Vision.

George Berkeley, Bishop of Cloyne, is I fear only known to the present generation as a somewhat ridiculous person belonging to

the first half of the eighteenth century, who enunciated and maintained a theory that matter does not exist, and that all states of consciousness are merely the expression of mental conditions. He was born in the year 1684, was admitted a Fellow of Trinity, Dublin, in 1707, and published his *Theory of Vision* in 1709. I do not intend to say anything as regards his life and other labours, which included the invention of a new remedy in the shape of tar water ; numerous diatribes against the mathematicians, particularly against the theory of fluxions ; and efforts to propagate Christianity amongst the inhabitants of the West Indies. I intend only to review shortly his theory of vision and to contrast it with more recent researches. Ample justice has been done to Berkeley by so learned and great an author as Huxley. He makes him the subject of one of his most charming essays. From many points of view the essay referred to is well worth reading. It gives an interesting glimpse of the great Bishop, and affords many important sidelights on the attitude of mind towards certain metaphysical problems of a man who was one of the greatest biologists of our time.

From Huxley's essay, and from other sources, we learn that the worthy Bishop of Cloyne was promised pecuniary assistance for his missionary projects by Walpole, at that time British Prime Minister. Huxley is all but lost in admiration at the force of character of anyone who could get money out of Walpole for any scheme which was neither business nor bribery.

In his first paragraph Berkeley defines the limits of his investigations. He says : "My design is to show the manner wherein we perceive by sight the distance, magnitude and situation of objects, also to consider the difference there is between the ideas of sight and touch and whether there be any idea common to both senses, in treating of all of which it seems to me the writers of optics have proceeded on wrong principles." From the foregoing it is obvious that the author only attempted to investigate a limited portion of the function of vision. Distance, magnitude and situation or alignment are three of the most important functions of vision, but they are by no means all. Colour is also a visual sensation, and so is that perception to which particularly the name visual acuteness is applied. There is no function of vision of equal importance with that of visual acuteness ; without it reading and writing would be impossible, and consequently, were it not

for its special power, human energies would be enormously curtailed. I shall have a good deal to say about visual acuteness before the end of this communication.

The estimation of distance is accounted for by Bishop Berkeley by the distinctness of the image. He entirely scouts all the reasonings of geometric optics. Thus we find him declaring that the lines and angles by which mathematicians pretend to explain the perception of distance are themselves not perceived or even thought of in the act of vision; and again that the distance of an object is not consciously estimated by the highness of an angle made by the meeting of the two optic axes, nor indeed by the greater or less divergency of the rays which arrive from every point to the observer's pupil. Even the act of turning the eyes does not seem to him to have much to do with the question. No doubt to some extent Berkeley admits that the estimation of the position of objects in space depends upon the rotation of the eye-balls from one point to the other; but what to him seems a certain explanation is the greater or less clearness with which the object is perceived. He states quite definitely that the nearer an object is brought the more confused it appears, which probably only shows that the learned and pious Bishop had that form of refractive error which is known as hypermetropia. The clearer an object the more remote he estimated it; the more difficulty he had in seeing it the nearer he judged it to be. Had the worthy Bishop only been shortsighted he would have come to quite the opposite conclusion, that the more confused the image was, the farther the object was situated from the person who saw it.

Yet, notwithstanding this attitude of mind, in paragraph 38 of his treatise he admits that there may be good use of computation by lines and angles in optics, "not that the mind judgeth of distance immediately by them, but because it judgeth by somewhat which is connected with them." Had Berkeley lived after Helmholtz instead of long prior to him he would have realized that this somewhat of which he speaks is nothing less nor more than the function of accommodation. The estimation of distance depends upon various factors, and probably differs according as whether the person who estimates is possessed of two useful eyes or only one. Let it be granted that the individual has two eyes available for distinct vision. There are at least three factors which help him to estimate distance. These three are Accom-

modation, Convergence, and what I may here call Relative Size Helmholtz was, unquestionably, the first man to give us a clear account of the mechanism of accommodation.

More recently Professor Tscherning, of Paris, has also written important papers on the subject. It is not possible in a short communication such as this, and perhaps not desirable to attempt in detail a discussion of the theory of Helmholtz as opposed to that of Tscherning, although I personally hold with the former; but it may be remarked that both are agreed as to the function of accommodation being brought about by a change in the curvature of the crystalline lens. The nearer the object, the stronger must be the lens which gives a clear image on a screen at a definite distance from the lens. In the human eye it is not possible to take out one lens and put in another, but, in early life, the change is brought about by the alteration of the curvature of the lens surface. It becomes more curved the nearer the object is brought. It is agreed on all hands that this change of curvature is brought about by muscular action. Thus, one feature in helping a person to estimate distance is the unconscious perception of this muscular effort; in other words, the muscular sense helps us to estimate distance, or, at any rate, to know that one object is nearer than another.

But the second factor is perhaps equally important. Accommodation rapidly goes with advancing years, and at and after 60 it cannot be said to be present. The nearer the object viewed, the greater the angle of convergence; the further away, the less the convergence, and when the object is very far away the visual axes are practically parallel to each other. The two human eyes are, in this respect, not unlike the totally reflecting prisms of that ingenious instrument, Barr & Stroud's range finder. If I am not mistaken, the estimation of distance in that admirable piece of apparatus depends upon movements of these prisms. The estimation of distance by human beings depends largely upon the angle of convergence made by the two eyes. Probably another function of binocular vision is parallax or something like stereoscopic vision. Under ordinary circumstances, and using the eyes without any artificial help, the stereoscopic element is not strongly developed, but unquestionably, with two eyes, we perceive better the relative distance of objects than we do when only one is used. Binocular vision has absolutely nothing to do with a sense of

alignment, it has to do with the estimation of relative distance. Consequently, a man with only one eye is able for almost any kind of manual employment, for that depends largely upon the alignment.

As regards number three, relative size, it is not so definite, but a person has, say, an idea of the average size of a man or of a two story house. Now, if he analyzes his sensations he will find that the farther a two story house is from him, the smaller does it appear, its apparent size being a function of the size of the image on his retina, and this decrease of the image is probably a not unimportant factor in helping the individual to estimate distance.

When a man has only one eye such information as is obtained in binocular fixation from convergence is entirely lost, but up till a certain time of life the individual has, no doubt, the power of accommodating, and the loss of one eye does not interfere in the least with the sense of alignment nor with this function of relative size.

Nor is the worthy Bishop more successful in the explanation which he gives of the estimation of the size of various objects. He denies entirely that it is by the estimation of angles, although he admits that an object at a near distance subtends a greater angle than when more remote. His views on this important matter are well expressed in the 56th, 57th and 61st paragraphs of his Essay. I trust I am doing no injustice to the learned author when I quote only the 57th, for it seems to me tolerably well to summarise the other two.

"Moreover the judgments we make of greatness do in like manner, as those of distance, depend upon the disposition of the eye; also on the figure, number, and situation of objects, and other circumstances that have been observed to attend great or small tangible magnitudes. Thus, for instance, the very same quantity of visible extension, which in the figure of a tower doth suggest the idea of great magnitude shall, in the figure of a man, suggest the idea of much smaller magnitude. That this is owing to the experience we have had of the usual bigness of a tower and a man, no one, I suppose, need be told." Oddly enough, in the last sentence, he seems to strike the nail on the head. The estimation of size is a matter of experience which is the combination of two factors, namely, the size of the retinal image and the

distance at which the object is placed. In a limited sense our perception of magnitude depends upon the size of the retinal image, but our consciousness of magnitude is not thus conditioned. In other words, a given size of retinal image does not always give rise to the sensation of an equal magnitude. Thus, a huge object such as a tower will, at a certain distance from the human eye give the same size of retinal image as a six foot rule, held at a nearer distance.

Yet we know that a six foot rule is not equal in size say to the tower of the University, although at different distances the retinal images are of similar dimensions. The sensations got from the size of a retinal image is mentally corrected, and it is mentally corrected very largely although not entirely by the estimation of distance. The apparent size of an object then, is conditioned by the size of the retinal image, and conditioned by the distance of the object from the person who sees it.

But Berkeley misses, all but entirely, the most important function of vision, namely, that property to which we give the name of visual acuteness. Without visual acuteness, as already stated, man would be unable to read or to write, and would be much curtailed in his energies. The only reference which is made to something like visual acuteness occurs in the 83rd paragraph.

"The visive faculty, considered with reference to its immediate objects, may be found to labour of two defects: first, in respect of the extent or number of visible points that are at once perceivable by it, which is narrow and limited to a certain degree. It can take in at view but a certain determinate number of *minima visibilia*, beyond which it cannot extend its prospect. Secondly, our sight is defective in that its view is not only narrow, but also for the most part confused; of those things that we take in at one prospect, we can see but a few at once clearly and unconfusedly; and the more we fix our sight on any one object, by so much the darker and more indistinct shall the rest appear."

Almost within our own time Professor Snellen of Utrecht tried to define the smallest object that could be seen, and on his researches founded those test-types which are all but universally used as a measure of visual acuteness. Unfortunately they have come to be regarded as an absolute standard instead of being, as they are, only an extremely useful comparative one, and the normal visual acuteness of mankind has not yet been determined.

Let us briefly illustrate what is meant by visual acuteness. If anyone take a page of print and look at a word about the centre of the page he will at once observe that while he looks steadfastly at the selected word he is unable to see almost any other word on the same page at the same moment ; possibly if there are one or two small words in juxtaposition he will be able to make out those immediately next to the one which he has selected, but the rest of the page will be to him at the moment entirely illegible.

As is well known this function which we have called visual acuteness is the special property of that part of the retina which is known as the *macula lutea* and extends to only a very small angle round the point of fixation. It is commonly called the form sense, which seems to me in great part a misnomer, for, if a person look at one part of a wall he will be at the same time aware of the form of objects placed at a considerable distance from his fixation point. Thus, to take a concrete example, if any member of my audience gaze fixedly at the chair placed immediately behind me, he will be conscious at the same time that the clock high up on the wall is circular. He will also be aware of the shapes of many other objects situated in the room.

Probably this faculty depends upon the light sense rather than on the visual acuteness, but still the fact remains that the sense of form in this wider acceptation of the term, belongs to the entire field of vision and is not restricted to the area of the macula. I prefer to use the definite term visual acuteness for that special function of the macula by which mankind is enabled to read small type and probably also to write. So far as the eye is concerned, it depends on the *macula lutea*, and there is every reason to believe that certain portions of the *occipital cerebral cortex* have to do with this special function.

Further, there is much evidence to prove that unless the visual acuteness is developed in early life it remains in abeyance. It is a matter of common notoriety that if in the first two or perhaps even three years of life a child begins to squint constantly with the same eye, that when maturity comes it will be found that the squinting eye is possessed of almost no visual acuteness at all. Donders of Utrecht was amongst the first to point out this fact and to emphasise it. He called this want of vision in the squinting eye *amblyopia exanopsia*, by which he meant blindness from want

of use. Now his explanation of the phenomenon was briefly as follows :—

He said that, if an arm were bandaged long enough, it became comparatively useless, so also, he said, in a similar way, if an eye was not used for purposes of vision it became blind or at anyrate lost its sense of acuteness. The facts must be admitted, but at the same time the analogy does not hold. The arm becomes powerless because the muscles undergo a certain amount of temporary atrophy and the nerves supplying them have diminished function. The eye becomes blind because it has never been taught to see. If the bandages are removed timeously from the arm it will rapidly recover its power, and probably in course of time will be as useful to its owner as ever.

An eye which in early life has not been taught to see in the sense of havig visual acuteness, will never in after-life attain that power. The cases are not analogous. If, for example, the squinting eye is put straight, a thing which happens constantly, the rectified organ may look perfectly well and even a critical examination will fail to discover by external observation that there is anything the matter. Yet vision in the sense of visual acuteness will never be gained by that organ. A few phenomena in this connection are well worth considering. Occasionally it happens that ordinary functional squint does not set in till after the patient is five or more years of age ; in other words, till good visual acuteness has been developed. Here it is found that in after-life, although the eye may have been allowed to deviate for a considerable time, still it never loses its visual acuteness, and that if the defect be remedied it at once becomes useful for vision. A still more striking example is obtained in that malady which is known as senile cataract. An eye may lose its vision by an opacity of the lens after it has served its owner for many years. If the cataract be successfully removed it is found that the visual acuteness has not been interfered with even by a prolonged period of inactivity.

In the case of the young child who begins to squint before the completion of his third year, it has recently been shown that the eye can be saved from impending *amblyopia*. The remedy is simplicity itself. All that has to be done is to make the child, by appropriate means, use the right eye and the left eye alternately, and in this way both eyes become possessed of ordinary visual acuteness. It is perhaps not wide of the mark to infer that when

amblyopia is found, it is abundantly explained on the supposition that the brain centres connected with visual acuteness for the squinting eye have never been developed at what may be called the formative period of the brain, and cannot be evolved at a later period. If, therefore, a child be compelled to use each eye alternately, then the brain centres in connection with each eye will be duly developed and the *amblyopia* avoided.

The most interesting cases are those in which in early infancy that form of lenticular opacity is found which is called congenital cataract. In a very large majority of cases the opacity does not affect the whole lens but only a portion of it, and thus parts which are still transparent are useful for vision. Probably the opacity in these cases interferes but slightly with the formation of a good image on the retina.

Thus, if an ordinary convex lens be taken and the major portion of its surface covered with some opaque substance such as a piece of paper, then it will be found that the remaining transparent part of the lens gives a perfectly definite image of any suitable object. Those who are familiar with the facts of spherical aberration will not be in the least surprised at this result. So far as the unaided eye can observe, the image given by a lens which has been in great part covered by an opaque object, is equally definite with that furnished by a lens which has not been in this way partially obstructed. There may be a difference in brilliancy but there is no loss in definition. In an almost insignificant minority of cases of congenital cataract the opacity is so extensive as to make the whole lens opaque, and consequently if both eyes are similarly affected then their owner is what may be called blind. He has no other visual sensations than those of luminosity. Luminous sensations exist independently of visual acuteness and form sense. Thus, if a person shuts his eyes and looks towards a window or other source of light, and passes his hand between himself and that source, then he is conscious, even through the shut eyelids, of the passage of the hand or other opaque object.

Differences of luminosity can thus be perceived through shut eyelids and probably are more easily distinguished through cataractous lenses for they are not so opaque as an eyelid. Take one of the rare cases of a child with congenital cataract so opaque that it is practically blind. The question arises, if by simple surgical procedure these opaque lenses are removed, will the child

see in the sense of having visual acuteness? So far as I am aware the answer must be in the negative. I know of no case on record where a person blind from congenital cataract, and who has been allowed to remain so by the inadvertence or carelessness of his parents or guardians till he has attained adolescence, ever had sight restored to him in the sense of being able to read ordinary type. Twice in my lifetime I have had such patients under my charge. In both of them ordinary surgical procedure was successful in perfectly removing the opaque lenses, and yet neither of them has ever been able to read ordinary type, and neither of them was mentally deficient. One of them had an extremely good scholastic career and mentally was above the average. He went to a school for the blind after the lenses were removed and had an entirely satisfactory course there. The other is a musician and although the opacities have been completely removed she is not able to be taught to read the notes of music. Yet she is quite able to come from her home near Dalmuir to see me in Glasgow without anyone to guide her.

The range of observation is of course limited, for the condition involved is extremely rare; yet I repeat that I am not aware of any patient who has had such an amount of blindness as to prevent in all the early years of life the visual acuteness being developed acquiring the power to read ordinary type. One other somewhat analogous condition obtains. A young child being left like its first parents to the freedom of its own will, offers, as may be most convenient at the time, either its left or its right hand to a stranger to shake. I have observed also a child to take a spoon either in the right hand or in the left hand as at the moment seemed to it most suitable. A stupid prejudice has made it the custom to forbid its doing so. A parent will direct the child to use the proper hand, consequently the infant is prevented from becoming ambidextrous. During the period of infancy and childhood means should be taken to compel a child to use its right hand and its left hand alternately, for if it did so at that period of life at which the brain functions are being developed, then the child would have the great advantage of being ambidextrous throughout life.

Lastly, do such views as I have been explaining shut us up to the old crude materialism of 30 or 40 years ago? Far from it. Do they not rather show that that subtle influence which we call

mind, in early life lays down those centres of the brain which in after life it is going to use? This is not the place, nor have I the time to take up at the tail end of an address such as this, a criticism of the old materialistic doctrine, but the more one studies the philosophy of sight the more one sees the necessity of predicated intelligence behind mechanism. A most interesting pamphlet on this aspect of vision is that of Laugel, entitled "Optics and Art." If I have not wearied you, and if I may again trespass on the boundless good nature which I have found so prevalent in this Society ever since I became officially connected with it, I may at some future time digest that most interesting monograph for your benefit.

Since preparing this address I have had interesting details of one of the two patients whose cases I have specially mentioned; namely, that of the student. Not only was his career at the school excellent, but he afterwards became a brilliant student in the University of Edinburgh. Unfortunately, he has passed over to the great majority, but at the time of his death he was engaged preparing for his University degree with honours in Mental Philosophy. Surely there was no lack of intelligence there, and yet he was not able to be taught to read. It is true that he could see in a certain way. He could see a piece of paper lying on a table, or other similar objects, and could even read large letters such as are used in bills on the street. In other words, he had just that amount of sight which depends upon the light sense, but he had not, in any degree, that function to which the name of visual acuteness is properly applied. Such persons seem to have those powers of vision which depend upon the light sense and no others.

An Occasional Peculiarity in my own Colour Vision.

By CHARLES R. GIBSON.

[Read before the Society, 4th November, 1908.]

IF we use the word *colour* as we ought to, to signify a sensation, it is evident that the subject of colour lies outside the domain of physics, and that the physicist has to deal, in this connection, merely with æther waves and revolving electrons. My own interests lie in physics, and although I have made no serious study of physiology or psychology, the subject I propose to bring before you must be classed in one or other of these two departments. My paper, however, refers to a personal experience, which seems to lead to a philosophical conclusion.

My colour vision is perfectly normal. Speaking in the accepted sense, I can distinguish all the colours in the spectrum of white light, and I am able to match every variety of colour without difficulty. But very occasionally I have observed the red sensation to have been absent entirely until it was called into action automatically by the brain.

The first occasion upon which I observed this phenomenon was some twenty years ago. Along with some friends I was looking over a collection of photographs for a stereoscope, and coming to the picture of a child standing among some rich foliage, I happened to remark that the effect was very pleasing, whereupon the others said that the colour spoilt it entirely. I was amazed, for the photographs were not coloured, and this particular one which was still before me appeared an ordinary photograph in black and white. I enquired where the colour was, and when the answer came—"the girl's red cloak"—I saw the cloak appear instantaneously a bright red. I was impressed particularly with the lightning suddenness with which the red colour appeared. It seemed as though the patch of red had been thrown suddenly upon the photograph.

For many years I was not conscious of any similar phenomenon, but about ten years ago another very marked case occurred. I

was cycling along a country road with my wife, and a lady cyclist was approaching us when my wife remarked—"What a blouse!" I saw nothing peculiar about the blouse; indeed I supposed the remark to refer to the style. But when my wife said—"What a flaring red!"—I saw it immediately to be of an exceptionally bright red colour, whereas it had appeared till then a dark nondescript colour. Again the suddenness with which the red colour appeared made a considerable impression upon me.

The last occasion upon which I witnessed this phenomenon was some years ago when I was present at a lecture on colour vision delivered by our worthy president, Dr Freeland Fergus, to the Paisley Philosophical Institution. During the evening the lecturer remarked that he would show some colour experiments upon the lantern screen. The hall was darkened and the lantern operator seemed to me to place in the lantern a dark slide which had a small circular hole cut in it, so that the effect upon the screen was a small disc of bright light upon an otherwise dark ground. I was under the impression that the experiments were to be made at the place where the small disc of clear light was seen.

It was some minutes before the lecturer, turning round to the screen, remarked upon "the bright red screen." Immediately I saw the whole lantern sheet to be a bright red. Indeed if there had not happened to be a clear disc of light on the screen previously, I should have supposed that the operator turned on the light only when the lecturer made this remark. I was so impressed with the suddenness with which the red screen appeared that I asked a friend, who was with me, how long the red screen had been exposed, and he assured me that it had been there ever since the hall had been darkened.

We were discussing the matter at breakfast the following morning and my friend insisted that I was in some measure colour-blind. Indeed, I find that my friends cannot get away from this idea, although I assure them that I have ordinary colour vision. I proposed on this occasion to apply the following test. There happened to be upon the breakfast table a red coloured tea-cosey, and I undertook to match this colour from memory by purchasing a piece of ribbon of the same shade of red. On reaching the city some hours later I entered the first drapery store I came to, and from a large selection of coloured ribbons, including a great variety of reds, I selected one which appeared to me to be exactly

the same as the colour of the tea-cosey in question. On getting home and comparing my purchase with the tea-cosey my wife declared that she could not have made a better match had she taken the tea-cosey to town with her.

It might be argued that the test I applied was one of colour memory, for doubtless the colour-blind man sees two similar reds to match each other, no matter what colour they may appear to him. Had a red-blind man, however, attempted the match, it is most probable that he would have brought back a dark-blue, of which colour there was an abundance among those from which I made the selection. I can produce plenty of evidence that I am not colour-blind in the least degree. As I go about the world I see red-coloured objects in a perfectly normal fashion, but it may be possible that on some occasions a red-coloured object fails to stimulate my colour sensation when I am not conscious of such failure, but at no time has an object, previously known to me to be red, lost its colour. On each occasion when I have observed the phenomenon referred to, I have been in my normal health. Perhaps I should mention also that I am practically a non-smoker.

This peculiarity in my colour vision is evidently a very occasional temporary red-blindness, which disappears instantaneously when I am informed that red rays are present in the light. As to the duration of the temporary red-blindness I can say little, as it is only when it is in the act of righting itself that I become aware of its presence. The most I can say is that it lasted several minutes on the occasion last mentioned, and did not disappear until I received the mental suggestion that the lantern screen was red.

There is no doubt that the bright disc of light should have appeared to me to be of a light greenish-blue colour, as the red rays of the white light would fail to stimulate my sensorium, but I have no recollection of observing this. You must remember, however, that the red-blindness only became known to me at the moment of its disappearance, so that I was paying no particular attention to the colour of the clear light.

It is obvious that congenital colour-blindness may be accounted for either as a defect in the visionary apparatus of the eye or in the sensorium itself.

John Dalton, who was practically the first to devote attention to the subject of colour-blindness, from which defect he himself

suffered, believed it to be due to some blue colouring matter in the vitreous humours of his eyes. This theory, however, was disproved after his death, for a post mortem examination showed that such colouring matter did not exist. There has remained, however, a doubt as to whether the seat of the defect lies in the eye or in the sensorium. The occasional peculiarity in my own colour vision would seem to support the theory that the seat of congenital colour-blindness is in the sensorium, for the defect disappears instantaneously whenever I become conscious that the red colour is present.

I have no doubt that this peculiarity, which I have happened to observe, may be present also in many others, but from the nature of the phenomenon it is obvious that it might easily pass unobserved.

To take the three occasions to which I have referred. If no one had remarked upon the colour of the stereo-photograph, I should have passed it over, unconscious that any red colour existed upon it. Had the flaring red colour of the lady cyclist's blouse not been remarked upon at the particular moment when my very rare red-blindness existed, the colour of the blouse would have made no impression upon me. The same red blouse would doubtless have appeared red to me on other occasions without any previous mental suggestion. And lastly, had not the red lantern slide happened to have a hole cut in it, I should never have observed the phenomenon on that occasion. Therefore it is clear that the phenomenon is one which may pass very easily without detection.

Unfortunately there still exists a tendency, on the part of those who are colour-blind, to hide the defect. Dalton found difficulty in obtaining information from others whose colour vision was defective, but this did not surprise him. He has told us that formerly when he used to call pink *sky-blue*, and incur the ridicule of others, he used to join in the laugh himself, and then nobody thought he was in earnest; nor did he think at that time that there was such a great difference in the appearance of colour to him and to others as he discovered to exist afterwards. He thought the difference was one of words, and not ideas.

There is one point which, although very simple, is perhaps worth mentioning. I have been asked sometimes why a colour-blind person should see blue instead of red; this appearing to the

questioner as a crossing of sensations rather than a blindness. The red-blind will, of course, only see a red coloured object *blue*, if the said object is reflecting both red and blue rays. The red-blind man will not see blue at the red end of the spectrum. He will tell you that he sees merely a deficiency of light at that end. It should be noted also that he is blind to the red component in the violet end of the spectrum. If we have the hall darkened I shall endeavour to show you how the red-blind man sees the spectrum.

For the sake of those who are not familiar with physical apparatus, I should mention that there is no coloured slide in the lantern; the white light of the lantern is being analysed or split up into its components. A narrow slit permits only a beam of white light to escape from the lantern, these parallel rays are focussed by means of a lens so that they fall upon a large liquid prism, and in passing through this the æther waves of light are refracted more or less according to their wave-length. You will observe that the long red waves suffer the least refraction, while the violet waves are bent far out of their original direction. I am indebted to the Physiological Department of the University for the use of this large prism.

If I insert a glass screen which will annul the red waves by absorption and prevent these long waves from reaching the prism, we shall see that the red of our spectrum has disappeared. Those of you who are quite familiar with the spectrum will observe that the violet end has also lost its red component. I am indebted to Sir William Abney for pointing out this fact to me, and it explains Dalton's description of the appearance of the blue-end of the spectrum. It shows us that his so-called violet sensation was perfect, the apparent difference which he describes being due really to the want of the red component in the violet end.

I shall endeavour to show you exactly what the red-blind man does see. I should mention that after obtaining, with the assistance of some friends, a good minus-red screen, through which one may view the colours and see them exactly as the red-blind man describes them, I found that the screen was insufficient to keep back all the red rays of the lantern unless I worked with a very diminished light. Sir William Abney was good enough to send me a sample of glass which he had found to serve the purpose better than anything else.

First of all I show you four pieces of coloured cloth which I asked two red-blind men to describe. I am indebted to the Staff Department of the Glasgow & South Western Railway Company for enabling me to get in touch with two men whom I found to be absolutely blind to red. I have marked the cloths with the names they gave them, and, if I have succeeded in making you all red-blind for the present, you will agree that the men described the colours correctly. But you will understand that that is not how I saw the colours while the men described them. When I withdraw the minus-red screen you see that the colours are not dark-green, dark-blue, pale-green, and pale-blue. They are in reality dark-orange, red, bright-yellow, and pink.

When I pressed one of these red-blind friends for as full a description as he could give me of this colour he happened to use the words "pink or light-blue." He had heard people call it *pink*, but there was no difference between *pink* and *light-blue*. If he were commissioned to buy a piece of light-blue cloth he would be willing to take this, and if he were told that he had made a foolish purchase he would think he was ill-used. I had an interesting conversation with this man, who would not be surprised to see me walking down Buchanan Street with a bright-red jacket as a match to a pair of navy-blue trousers. Indeed he assured me that the vanmen on the Railway wore trousers of what I chose to call bright-red, but what to him was in reality a very dark-blue.

When Dalton received an invitation to proceed to Paris to meet the French savants, he called upon his tailor in Manchester and ordered a suit of clothes suitable for the purpose. Here is the kind of cloth ordered by Dalton (appears a dark-blue), and had the tailor done as he was told, Dalton would have appeared before the Parisians in a complete suit of this cloth, which is only used for scarlet hunting coats.

Here we have four hanks of coloured yarn. I took bobbins of these, mixed them together, and then asked my two red-blind friends to pick out any that were at all like one another. They very naturally selected those two "greens" and placed them together, and then those two "blues" were declared to be similar. That is the reality to the red-blind men, but here is the reality to those with normal vision. You see that they have matched an orange to a green, and a pink to a light-blue. It is obvious that, as the orange colour is a combination of red and green, the red-

blind man will see only the green. And although the pink yarn reflects both red and blue rays, he sees only the blue.

The foregoing experiment will serve to demonstrate the Holmgren Wool-test. As the wools are rather small to show to an audience in this light, I shall show you these when we have finished with the lantern. Here is the colour test used by some railway companies. This card is held at various distances from the applicant, and he is asked to describe these colours. If he is red-blind, as we are at present, he will name them light-green, blue, dark-green, and black, but if he has normal vision, as we have now, he will have no difficulty in pointing out the yellow, blue, green, and red.

My last experiment is to demonstrate the fact that colour is not part and parcel of the so-called coloured object. Here we have some Mercury Biniodide, which you might describe as *possessing* a bright-red colour. The facts, as far as modern science can fathom them, may be stated in a few words. Electrons, revolving round the atoms in the heated lime of the lantern, are setting up a great variety of æther waves, including frequencies from 400 billion to 750 billion per second, these being the æther waves which affect our visionary apparatus. These æther waves falling upon the substance before us are stopped by the satellite electrons of the atoms forming the substance. Some of the electrons happen to be capable of revolving in exact sympathy with the waves of low frequency, and these set up a fresh set of waves of the same low frequency, which are, of course, the waves that stimulate our red sensation. It is apparent, therefore, that if we prevent these low frequency waves from reaching the substance, these sympathetic electrons will not set up those low frequency waves which we observe at present by means of our red sensation. We use the minus-red screen and prevent those low frequency waves from reaching the Mercury Biniodide, and you observe that the substance does not possess any colour. Of course, it still possesses the satellite electrons capable of revolving at about 400 billion revolutions per second, provided we set them in motion by æther waves of that frequency as we do when we let all the variety of waves, set up by the electrons in the lime, fall upon them. Once more you see the substance red, but it must be clear to all that the colour is not part and parcel of the substance.

It only remains for me to show you the wools of the Holmgren

Test, which the Glasgow & South Western Railway Company have been good enough to lend me. I gave one of our red-blind friends this bright rose-pink wool and asked him to find anything like it among those. He was, of course, able to pick out the wool which did in reality match, for whatever the rose-pink colour appeared to him it would be a match to itself. Coming up among the blues here, he tried the rose-pink alongside of one and then another, and finally selected this bright blue as a very fair match to the rose-pink. Viewing these two colours through the minus-red screen I found they appeared very good matches, so that it was evident that the man was absolutely red-blind, and that the screen gave a true imitation of his vision.

Memorial Notice of Mr JOHN ROBERTSON, late Hon. Librarian of the Society. By Professor J. G. ROBERTSON, M.A., B.Sc., Ph.D.

[Prepared by request of the Council and Read before the Society,
18th November, 1908.]

MR JOHN ROBERTSON was born at Jamestown, in the Vale of Leven, on July 6th, 1836. He was educated at the Bonhill Parish School where he subsequently became a pupil-teacher. In 1855 he came up to Glasgow and entered the Church of Scotland Training College there as a Queen's Scholar. At the end of two years he was appointed Master of the Milton Sessional School, then supported by the Barony Church and under the management of the Rev. Dr. Norman Macleod. Mr Robertson carried on the work here with conspicuous success for eleven years, and had time as well to write an excellent English Grammar, founded on practical considerations of the best way of teaching the subject. The particular merit of this little volume lay in its method; it broke entirely new ground as far as the teaching of the mother tongue was concerned. Here for the first time, at least in an English book, the attempt was made to overthrow the tyranny of Latin grammatical methods in the study and teaching of English grammar. The leading principles of Mr Robertson's book were that the science of grammar should be approached by way of analysis, and that if we are to understand properly the structure of the English language our knowledge must be based, not so much on the laws of Latin grammar as on those of Anglo-Saxon. Mr Robertson's *English Grammar*, besides being reprinted in America, and officially recognised as a school text-book by the Government of New Brunswick, has been sold in this country to the extent of upwards of two hundred thousand copies.

In the beginning of 1868 Mr Robertson was appointed a Lecturer in the Glasgow Church of Scotland Training College where he had been a student. The success which he had met with as a teacher in the Milton School followed him here, where his duties lay not in the teaching of children but in the preparation

of teachers. His teaching of grammar in the Training College met with the special commendation of Matthew Arnold who was then an inspector in the service of the Education Department. Mr Robertson had also the opportunity of conducting classes in botany, a subject to which at that time he was giving special attention.

Mr Robertson's connection with the Training College came to an end in 1877, owing to internal dissensions in the Institution, which led to the resignation of the greater part of the staff. Since that period down to two and a half years before his death he was in the service of the School Board of Glasgow. For five years he was headmaster of Parkhead Public School, for other four and a half years of Gorbals Public School, and finally, for fourteen years of Woodside Public School. He resigned this position in June, 1904, thus bringing to a close a teaching career extending from first to last over fifty-four years.

As a headmaster Mr Robertson showed conspicuous ability as a practical organiser, and the School Board, early recognising this, frequently called him to their aid in connection with schemes of educational reform. The most important of his services in this way was the organisation and establishment of central classes for the training of pupil teachers, a scheme which ultimately resulted in the creation of a Pupil Teachers' Institute.

Mr Robertson was a Fellow of the Educational Institute of Scotland and of the Headmaster's Association; and all his life long he took a warm interest in all schemes for the improvement of the status and conditions of the teaching profession; and he was at all times generous and ready with help and advice. It may be said in the most literal sense of the term, that he enjoyed the universal respect and esteem of his colleagues. The English Grammar was not Mr Robertson's only contribution to educational literature. For many years he acted as educational adviser to Messrs William Collins & Sons, and prepared for that firm several series of reading books to meet the educational requirements of the day.

Even after Mr Robertson's resignation of the headmastership of Woodside School, his interest in education did not cease. In the spring of 1906 he was induced to become a member of the School Board of Cathcart, and, down to his death on January 14, 1907, he carried out most actively and faithfully the duties of that office.

His great practical knowledge and experience of the organisation and working of a modern public school were deeply appreciated by his colleagues on the Board.

Reference has already been made to Mr Robertson's interest in botany, but this was only one of his many scientific interests. He lived in an age in which the natural sciences stood as never before in the foreground of public interest, and he shared that interest to the full. A diligent student of chemistry and geology as well as botany, he followed with enthusiasm the rapid advances which these sciences made in the third quarter of the nineteenth century; and in later years he looked back on the publication of Darwin's *Origin of Species by Means of Natural Selection*, and the epoch-making theory of biological evolution as one of the greatest experiences of his life. Himself a warm adherent from the first of Darwin's doctrines, he was perhaps a little in advance of his time, in realising the possibilities of the theory of evolution as applied to other fields of human knowledge; and although an unqualified admirer of the great Victorian scientists, especially Huxley and Tyndall, he was not blind to the serious disadvantages of a regime of scientific materialism. The progress of science in recent years has more than justified his distrust of the dogmatism of the pioneers with regard to the limits and limitations of the knowable.

It was this warm interest in natural science that first brought Mr Robertson into touch with the Philosophical Society. He was also, it might be noted, a member of both the Geological Society of Glasgow and the Natural History Society. With regard to his connection with the Philosophical Society and its library, it will be best to quote Mr Robertson's own words, expressed on the occasion of a dinner given on 26th September, 1901, by the Council of the Society to its honorary treasurer and honorary librarian. "Becoming a member," he said, "forty-one years ago at a time when I was an ardent student of analytical chemistry—a branch to which I had then the ambition to devote my life—and a student in a less degree of physics and of botany as a recreative science, I daresay I was the most regular reader in the library. It was of immense service to me in those early days, and hence it is I can say that, if I have done something to render it serviceable and accessible to the members, I have been amply rewarded by the pleasure and profit I myself have derived from its valuable stores. Enough perhaps has already been said with regard to my

personal connection with the library. For many years it had been grossly neglected, the books and periodicals were scattered in disorder over the shelves. Very many numbers and volumes were wanting. They had never been received or had been lost. Indeed, no record was kept to show that publications came regularly or ever came at all. Mr Dixon, afterwards of Allan Glen's School, was my predecessor in office. He set to work to put things right, and to prepare a catalogue on the plan adopted at the University, but the great demand it made on his time and the irksome nature of the duties brought his resignation before the end of the session and I became librarian. Fortunately for the library circumstances enabled me to devote to my duties the whole of my time for the first year. The books were arranged and every effort made to fill up the gaps. In two years the catalogue devised by Mr Dixon was completed. It formed a single large volume such as is to be found in the Mitchell Library, and lay on the table where it may still be seen. As might have been anticipated, it did not meet the wants of members who wished to possess catalogues of their own. In 1880 the Council authorised the construction of a new catalogue as soon as the books could be properly arranged in the present premises to which the Society had just removed. It was issued in 1883 and is the catalogue at present in use.*

* This second catalogue, a volume of 368 closely printed pages, was completed and published in 1904, and at the Annual Business Meeting on 30th November of that year, the Society marked their appreciation of the value of the work by unanimously resolving "That Mr John Robertson be presented with an honourarium of fifty guineas for special services rendered to the Society in connection with the preparation of the new Library Catalogue." Mr Robertson was not present at the meeting, but wrote the following characteristically modest acknowledgment to the Secretary :—

"Dear Dr Fergus,—Kindly convey to the Council of the Society my hearty thanks for their handsome recognition of my services in connection with the preparation of the new catalogue of books in the library. Although the work was laborious, it was a labour of love, and I should have preferred a simple expression of thanks ; but the Council, in their goodness of heart, having agreed to the proposal, I accept the cheque as a tangible token of their appreciation of my services, and of their satisfaction with the resulting volume.

"I am, faithfully yours,

"JOHN ROBERTSON."

It may be explained that although the "Council" only is referred to in the letter, the grant was made by the Society on the recommendation of the Council.

"On the completion of the twentieth volume of the *Proceedings* in 1889, I undertook to prepare an index to the twenty volumes. It was supplied to the members in 1892. In time, the constant increase of the books in the library rendered a new catalogue again necessary and for some years I have occupied my leisure in its preparation. It will be a dictionary catalogue of considerable size and every effort is being made to have it ready for the Centenary at the beginning of next session. There will still remain a duty I am willing to discharge, should the Council desire it, namely, to index the volumes of our *Proceedings* published since 1889. If I am permitted to complete that piece of work, it will probably be my last service as librarian to the Philosophical Society where I have formed so many valuable friendships and whose meetings have been the source of deepest interest to me for so large a portion of my life."

Mr Robertson became a member of the Philosophical Society in 1860, and its honorary librarian in 1876.

The value of the work which he undertook single-handed for the library of the Philosophical Society can be appreciated by all its members ; but only one who has had experience of the irksome and monotonous work of cataloguing can fully appreciate the unflagging zeal and earnestness with which he carried it through ; and indeed this earnestness and the unflinching conscientiousness in everything to which he put his hand were characteristic of him all his life long. In the work for the Society may also be seen in a high degree exemplified that genius for classification and organisation which had been of so great service to his profession as the head of a great public school.

Some Causes of Crime. By JAMES DEVON, Medical Officer, H. M. Prison, Glasgow.

[Read before the Society, 18th November, 1908.]

THERE seems to be general agreement that our prison system is a failure. It keeps people off the streets for a longer or shorter period ; and as a rule they leave it in better condition physically than when they entered ; but, thanks to their seclusion and to the habits they have learnt, they are less fit to obtain work, and to perform it, than they were before their imprisonment. Their experience does not deter them from repeating their offences ; and it does tend to sink them in the mire. No one ventures to suggest that the prison is a reforming agent. There would seem, then, to be some reason for enquiry as to the cause of its failure, or even as to its purpose at all, before setting up other prisons under new names ; but that is not the way we do things in this happy land. Prisons failed to reform inebriates. Why? The answer to the question might have explained their failure with regard to other prisoners—why institutions usually fail, even under rational management. Inebriate homes were started, and they have not been a success—to put it very mildly. They have done some harm, which is never taken into account, in destroying what sense of initiative their inmates had ; they have cost a good deal more than the prisons ; and they have reformed very few. If they are not to be judged by their results, by what are they to be judged? If a business firm set up a department to do certain work, and found that the work was not being done, while the money was being spent, there would be a very rigid enquiry as to the causes of failure. I would not for a moment suggest that government is a business concern ; but surely it would not be altogether foolish to attempt to find out in what respect the treatment of inebriates has been mistaken, before seeking to obtain further powers.

There is a call for the classification of criminals. This is a recognition of the fact that offenders are not all alike ; but we need to recognise that they are all different, before there is any chance of our doing them much good.

We have all many more points of similarity than of difference ; but it is the differences that mark us off from one another, and make it impossible to rule one man's life in detail by that of another. To call crime a disease, is to get into a bog ; but the methods of the physician may be applicable to the treatment of the offender. It is only the quack who treats diseases ; the physician treats the patient ; and if we desire to treat the criminal—to cure him of his habit or propensity—we must learn something more about him than that he is guilty of a certain offence. If the physician does not recognise the fact that he never gets two cases exactly alike, and fails to allow for the personal equation, he may kill though he meant to cure. I have frequently pointed out that though we have abundant opportunity of acquiring knowledge, it is nobody's business to do so ; and no systematic attempt has been made, or is being made, to obtain it. We are too busy talking about "Men" to attend to MAN.

It is one thing, however, to prescribe for the treatment of the criminal, and another matter to examine conditions that favour the commission of crime. To continue our analogy, the one thing is like the work of the physician, the other is like that of the Medical Officer of Health. Just as certain conditions favour the spread of disease in a community, there are conditions that engender crime. Many are able to resist these noxious influences altogether, some resist them partially, others there are that break down completely under them.

It has been said that every community has the number and kind of criminals it deserves. Ours are many and varied, as are our laws. Every year, when the prison statistics are issued, we hear from the newspapers what a terrible place Scotland is !

In proportion to the population, we have a very large number of committals to prison. That this is not in itself sufficient to justify the conclusion that we are worse than other countries, does not seem to occur to those who supply us with our opinions. The number of prisoners is no index to the number of offenders. It depends largely on the view the officials take of their duties, and the zeal with which they carry out their work—on the penal regulations in force and the efficiency of their administration. The more offences you create the more offenders you are likely to have. That we have far too many acts made punishable, is a debatable statement—but it *is* debatable ; that we have too many offenders

I do not for a moment deny ; but it is simply foolish to compare two countries where important factors differ so much as they do in Scotland and England. Let us set our house in order, without regard to whether it is better or worse than that of our neighbour.

One of the most common statements in all official reports is that the great majority of those in prison are there through drink. It is quite true ; but as it stands it is not very illuminating. It is seized on and repeated on all occasions—often by moralists who do their full share of drinking and have no intention of giving it up. It has taken the place held for so long by our old friend “Heredity” as a quite sufficient explanation of all crime, and of most other evils. We inherit all our faculties and powers, but what they are we do not know till circumstances reveal them. In the same sense, everything is due to heredity ; for you cannot take out of a man what is not in him—but you can avoid taking out of him all that is in him.

One set of qualities may be developed to the exclusion of another, but they may be directed to a good or to a bad use. To assume that only some qualities are inherited, because we think we can trace them, is to go as wide of the facts as it would be to assume that we know all our own potentialities. Both assumptions have been made ; with the result that some men’s good and other men’s bad deeds have been attributed to heredity—which is as good a word as any other to cover our ignorance. It was seized on as an excuse for allowing social conditions to remain as they are ; and was a convenient way of transferring blame from our own shoulders to those of our ancestors. The practical application of all doctrines of heredity simply amounts to this : that as no conditions are equally suited to all men, some do well in surroundings that are fatal to others. The social problem is, to place men where they will do best ; and the political problem that faces each generation is, how to adapt existing customs and laws to present and pressing needs, with the minimum of disturbance. Drink is denounced—and consumed—by all classes. All evils are attributed to it ; and for one man who, believing in the theory, takes the logical course and becomes an advocate of prohibition, you have a score who will do nothing to remedy social conditions because “you never can stop men from drinking ;” and if drink be the cause of all evil, and you cannot stop drinking, why should they worry ? Any theory of evil will be fashionable if it fits some

of the facts and offers an excuse for doing nothing but giving good advice to the poorer classes. Drink has brought misery and degradation on millions, through their own indulgence or that of others ; if it does not cause, it always aggravates poverty ; so far from desiring to minimise its evils, I have all my life shown my belief in its danger by personal abstinence from it ; but I protest against the practice of singling out one from among our vices and attaching to it the blame of all our social evils—and the fact that it may not be our personal vice does not make the practice more worthy. By all means let us endeavour to lessen drinking ; this too we shall do most rationally if we search for its causes. To-night, however, we are not considering vice, but crime ; and the question is :—How far, and in what sense, is the statement true that nearly all crime is due to drink ?

The great majority of persons in prisons are there for committing petty offences. Strike them off, and your prison population would be at once reduced by a half. They have been drunk and incapable of taking care of themselves, or they have committed a breach of the peace through drink. Their sentences are short, and their number is large. Whether we are doing wisely with them is a question which will bear discussion. I have clearly indicated my views on the subject on a former occasion in this place. At present they swell our prison statistics, and are a burden on the exchequer. That they should be mixed up with criminals is no advantage to us or to them. The cause of their imprisonment is drink ; but it does not make for clearness of statement to add their numbers to those of the criminals who have committed offences against the person or against property.

Intoxication shows itself in different ways in different persons, and produces different effects on the same person at different times. People take drink to get out of themselves ; and they are then in a condition to say and do things from which they would refrain if sober. Tendencies which are ordinarily repressed or controlled may assert themselves, sometimes with disastrous results. We are all liable to lose our temper at times ; but we learn to control our wrath. Some men when under the influence of drink develop very bad temper indeed, and, not being able to control it, expend it in blows.

Most of the serious offences against the person are committed by people under the influence of drink—sometimes by people who

are quite good-humoured and peaceable when sober. More commonly, however, serious assaults committed by "drunks" are not so much the result of anger as of cruelty. It is matter of common observation that a man can and does develop a kind of dual personality; he shows one set of characteristics when sober, and a different set when in liquor. In both states he receives impressions. His actions when intoxicated show that the impulses which direct his acts are different from those which are dominant when he is sober. Just as his sober self is forgotten when he is drunk, his drunken self is forgotten when he is sober—not wholly, but in part. Impressions received in one condition, tend to be revived when the person is again in that condition. When a "drunk" who gets quarrelsome hits out, if he finds he has struck one who will strike back he generally clears out of the way and avoids the danger from that kind of person on subsequent occasions. If the victim of his ill-usage bears it, the lust of blood seems to stir him to continue to strike blindly. This passion of cruelty appears to possess some men regularly, and is indulged at the expense of those who offer least resistance to it, viz.:—the female members of their household. In nearly all cases of brutal wife-murder that have come under my observation, the fatal assault has simply been the last of a series committed regularly when the culprit was under the influence of drink; and the women's death was the final incident in a long drawn out martyrdom. Another class of assaults is that committed on persons who are under the influence of drink, and who by their misconduct have provoked their assailant. Such cases are relatively few, and the assault is rarely so serious or so brutal in character.

When we consider the influence of drink in the causation of crimes against property, we are on more debatable ground. Just as it causes some people to become violent, drink causes others to become mischievous. If a man lift things that do not belong to him and carry them off, that is theft and is punishable as such. Of course if he could state the case to a magistrate as a lawyer would, it would be classed as malicious mischief—what it is; but if the culprit could afford a lawyer he might not be in a court at all, any more than the young bloods who commit occasional depredations on property and compensate the owners when brought to book. It makes a big difference to a labouring man whether he is convicted of malicious mischief or theft; not merely with

regard to the sentence. In the one case he is simply considered foolish by those who hear of it ; in the other case he is branded as dishonest ; and it is much more difficult for him to obtain employment. The name of "thief" sticks most persistently, and in recklessness or despair the dog with the bad name may deserve it, and permanently find a place among our professional criminals. In such cases the man can trace his downfall to drink ; but he might also reasonably place some of the blame on our stupidity in dealing with him.

There is a number of people who, originally law-abiding citizens, through indulgence in drink have fallen from their former estate, and having lost their self-respect are ready to do anything to satisfy the craving which consumes them. They cannot get work, and could not keep it if they did, because of their unsteadiness ; so they live by begging and by stealing. The offences they commit are the outcome of drink.

The most troublesome and dangerous criminal is the professional ; and no more than other professional persons does he go to business the worse of drink. It would be taking an unnecessary risk to do so. The fact is, a man can attend to his business best if he keeps sober—whether that business be an honest or a dishonest one. Get your professional thief in prison and ask him why he is there, and very likely he will tell you it is all on account of the drink. He knows it is the fashion to trace all crime to that source, and he is not particularly anxious to gratify curiosity as to his past. There is also a chance of obtaining some sympathy, that may materialise on his liberation. It may also be quite true that "if it hadna' been the drink I wadna' been here," as he usually puts it ; but a little patient enquiry will show that he is dishonest when sober—that for every time he has been caught there are many times he has escaped, and that what he means is, either that the drink obscured his judgment and caused him to undertake a job he would otherwise have left alone ; or it made him forget to observe some precaution he should have taken. He is not a thief because of the drink ; but a thief who is caught because he has taken drink.

It appears, then, (1st) That the great mass of prisoners were under the influence of drink at the time they committed the offence for which they have been convicted. (2nd) That of these the "crime" of the majority is drunkenness, or some petty offence re-

sulting therefrom. (3rd) That nearly all the crimes against the person are committed by, or upon, people who were intoxicated at the time. (4th) That many offences against property are the result of drink. (5th) That the majority of crimes against property are not due to drunkenness, at least on the part of the criminal.

Is the amount of crime in Scotland dependent on the amount of drinking done? I understand that drinking and even drunkenness is not confined to our cities, yet no considerable portion of our prison population comes from the dwellers in the country or in the small towns; so that you have the vice present without the crime. The drink itself has the same effect on the drinker's body and mind whether he is in the town or the country. In the country, where people are not packed together—even in small towns where the population is spread out—they have room to see their neighbour. They take some interest in each other; indeed one often hears complaints of too much attention being paid by villagers to their neighbour's affairs. The publican knows his customers, and it is neither to his interest nor to his inclination to let them have too much. He is just like other people in his desire to have the respect of his neighbours; and you cannot be respectable and outrage the public opinion of the place in which you live. If a man does get more than he can carry, there is usually some one to see him home; and if he shows a tendency to play the fool or to become violent, friendly hands restrain him from doing the mischief he would otherwise do. When there is not this restraint and help, and when opportunity is present, you are just as likely to have crime resulting from drink in the country as in the town. In the city a man may, and sometimes does, brutally assault and even slay another person, while people are living above, below, and on each side of him, and no one troubles to look in and enquire as to what is going on. Men do not know the people about them, and do not care to interfere in strangers' affairs. They have learnt to attend to their own business, and to leave other things to their paid officials. The officials likewise attend to their business, and the prison cells are filled with people who have taken liquor in excess and have had no friendly hand to assist them or keep them out of mischief.

Every now and then we learn from the English newspapers that we are the most drunken city in the kingdom; and people write and tell their experiences of sights seen in our streets, and quote

statistics of the arrests for drunkenness in the place which is at other times described as the most progressive in the world—"a model municipality." That the streets of Glasgow (or rather a few of them) are disgraced by the drunkenness of some who use them, I am not concerned to deny; but the fact that some travellers at some times see more drunk people within a given space than can be seen in any English city, does not at all justify the inference that Glasgow men are more drunken than the inhabitants of those other cities. In none of the great English towns will you get such a large population on such a small area. If there are more drunks in a given space there are also more sober folk, but only the drunks are observed. As for the statistics of arrests, they are absolutely useless for purposes of comparison, if it were only because of the different practices that prevail in different parts of the country in dealing with drunks. It is also well known by this time that a comparatively small number of people are responsible for a large number of arrests.

I think the facts show—(1st) that drink puts a man into a condition in which he is more liable to commit a crime or a police offence than when sober; (2nd) that while drinking is common in all parts of the country, police offences and crimes occur mainly in closely populated districts; (3rd) that the amount of crime and police offences in Scotland is not dependent on the amount of drinking alone, but is mainly dependent on indulgence in drink under certain conditions of urban life; (4th) that the major portion, and the most serious kind, of crimes against property, are not attributable to drink.

Just as most prisoners were the worse of drink when they committed crimes or offences, so most of them were poor. It is not customary, however, to infer that their crimes were due to their poverty; nor do they themselves attribute their wrong-doing to that cause. There are many who are most estimable citizens though poor; poverty alone does not lead them to prison. On the other hand there are many people who drink to excess and do not transgress the law. Their drunkenness alone does not lead them to gaol. It is sometimes said that poverty, and especially the poverty of the masses, is the result of drink. The statement is grotesquely untrue. That drink aggravates their poverty is quite obvious; but no one can shut his eyes to the fact that all poor people do not drink; we have all known teetotalers

who are not rich. Drink is often a cause of poverty; but to attribute poverty mainly to drink, is wantonly to libel the poorer working classes, many of whom live far cleaner lives than their critics. On the other hand, it is equally unsafe to attribute drinking mainly to poverty. There are many who indulge very freely and cannot be called poor. The practice is not peculiar to any social condition. That many are driven to drink as a refuge from the monotony of their lives, is undeniable; but if poverty makes some men drunkards, it makes others teetotalers. There are a good many who abstain because they want to "get on"; and they see their chances are less if they do not keep strictly sober. When they do gain a better livelihood, they drop their teetotalism—sometimes greatly to their loss.

Poverty is not a common cause of offences against the person; and few people commit thefts because of their poverty; but of those in prison as petty offenders—the largest class—a great many have been driven to offend by the squalor of their surroundings. Poverty tends to limit a man's choice in work and in recreation. It causes him to live under conditions in which his vices may easily develop into offences or crimes. It keeps him so busy in the endeavour to provide for his pressing wants, that he has no time to interest himself in the duties of citizenship. It makes him less able, when he has committed an offence, to recover from the results of a conviction, and more liable to become an habitual offender. It cannot be said that the amount of crime in Scotland is in relation to poverty alone. In some parts of the Western Highlands and Islands the poverty is appalling, and yet there is an entire absence of crime.

All experience shows that crime occurs, not in proportion to the number of the population, but to its density. Not only is there more crime in the city than in the country, but the densely populated parts of the city produce more criminals than the less crowded districts. With crime, as with disease, the intemperate person is most likely to succumb. We are constantly being told by our sanitary authorities that the city slums are breeding-grounds of disease, and that disease bred there does not confine its ravages to the slum-dweller, but may easily infect those of us who live under more wholesome conditions. The principle holds equally good with regard to vice and crime. If we would let in the light and fresh air, we would be saved a great cost in money

and in lives which present conditions ruin or destroy. Just as certainly would we break up the aggregations of people whose acquired way of living is fatal to the development of any proper civic spirit. There they are ; born into boxes of houses, packed in rows, and laid in layers one lot above the other, in the air. Their home life is lived in similar boxes ; and when they die they are put in smaller boxes and placed in layers in the earth. The Health Officer would speedily interfere if we attempted to house as many pigs to the acre as we do human beings ; but there are fewer people making a living by furnishing accommodation for pigs than for men ; and it is easier to regulate an occupation which is not influential than one that is. It is much easier to punish a slum dweller for breaking our sanitary regulations, than a slum landlord for living off rotten dwellings. It is well known that the worse the property, the bigger the rent charged in proportion to the accommodation offered. If a man owns house property he expects to make a profit when he lets it, from the difference between what he has paid for it and the rent he receives from it. An old woman is desirous of keeping out of the poorhouse—and in spite of all we, who hope never to go there, can say about the advantage to the poor of their having the evening of their days regulated for them by our officials, and the expense of their keep defrayed by us, there are a great many poor people who are so blind to their own interest and comfort that they adopt all sorts of expedients to keep out—she rents a small house and takes in a lodger or two. She intends to make her profit from the difference between what she gets and what she pays. The sanitary authorities find that she has too many lodgers, and she is sent to prison for overcrowding. Of course there is a difference between her and the landlord, for she has broken the law. Precisely ; but what kind of law is it that can reach only the poorer transgressor and allows the partner in profits to escape ?

Overcrowding not only breeds disease but it tends to destroy the sense of decency. I do not enter into details ; a true description of the conditions under which thousands of our fellow citizens live in this respect would be too lurid ; though if we are to consider the circumstances that make some kinds of vice and crime so easy, and almost so natural, to many, attention will have to be given to this aspect of city life. In some parts of the city

there is literally no room for the people to live. A place to sleep in, to shelter from the weather, to take food in? Yes. Room to have recreation or quiet? No. The forbearance, the good humour, the willingness shown to stand aside and allow another member of the family to monopolise the scanty accomodation, is wonderful; and it is the rule. Now and then, here and there, a breakdown occurs; and if it results in a breach of the peace the authorities are scandalised. A stairhead quarrel is a fair subject for the humourist; but try and live even for a week in such close and constant contact with anyone, earning the while your living by exhausting work, and your wonder will be that the peace is kept so well. The fact is, that those people put up with a great deal more than their rulers would stand; and that is one reason why they have to stand it. If they were as impatient of our smug-faced bungling as we are of their transgressions, we should have learned how to regulate our cities long ago. There is a great effort made to evangelise the poorer classes, and it is well supported by those who are better off; it would not be a bad thing—it would be no worse a thing—if the slums returned the compliment and set out to evangelise the West-end.

There is no slum district in the city that does not contain a larger number of well-disposed than of evil-disposed persons; but a close may get a bad name through the misconduct of one or two of its inhabitants, and a street, from a minority of rowdy persons in it, may be regarded as wild. We take no account of those who do not annoy us, and when the noisy people anywhere assert themselves, we forget all about the others. When we interfere officially, we find that, good and bad, they stand by one another. In this respect they are like gentlemen; they do not give each other away. It is an interesting commentary on their view of the law, that they do not look on the authorities as their friends. Many of them are quite as self-respecting as their better-off fellow citizens. Some could afford to live elsewhere, but remain where they are because it has never occurred to them to remove. They have gone to the district when both it and they were not so old—in its better days. The change in its character has been so gradual that they have not noticed it much; and they stay on just as men stay on at business long after the need has passed, because they cannot think of doing anything else. It is not good for them that they should do so,

but it is not bad for the slum ; for old inhabitants of this kind exercise a good influence on many of the others.

Most people do not dwell in slums because they like that sort of thing, but because they are unable to pay for better accommodation. The smallness of their dwellings makes healthy home-life difficult if not impossible, for there is neither space for privacy nor for recreation after work, unless all the members of the family are prepared to take their recreation in the same way at the same time. Having no room in the house, the man goes out to seek a change. The places of public recreation to which he can go are few. The public bowling greens are greatly run upon, and are of course only available for a part of the year. Our libraries—so far as their reading rooms are concerned—are not much used by him. Picture galleries and museums appeal to only a very limited number of our fellow citizens, working-class or otherwise. It was once—perhaps is still, but I hope not—the idea of those who pleaded for the provision of public means of recreation, that they should be of such a character as to “improve” the working-classes. The intention was excellent ; but the people themselves were left out of consideration. Perhaps they do not believe that conformity to our ideals would be an improvement ; at anyrate, the great majority have not shown any eagerness to take advantage of the opportunities to study science and art which we have showered upon them ; and they remain quite as regardless of these twin goddesses as the great mass of the richer people who quite honestly desire to elevate them. The private caterer has found a way to interest them, however. If he failed to do so he would lose his own livelihood ; and the consciousness of that fact may have sharpened his powers of perception. He has to amuse men as they are ; not as he thinks they ought to be. Our regulations quite properly debar him from doing this in an objectionable way. The entertainment provided may not be of a high order—indeed some performances are so inane that it is surprising that anyone can tolerate them—but the purpose of recreating thousands is served. If we regret that people should not seek something better, let us remember the monotony of their lives, the numbing effect of their conditions, and be thankful they do not seek worse. A life so huddled as that of our poor, implies the exercise of a great amount of self-restraint. I am aware that it is not a quality which most of them are credited with ; and that it is the defect of

it which causes a great many crimes ; but a little consideration will show that life under the conditions in which they live would be impossible, if they were as evil tempered as many of them are credited with being. When they are angry with one another they cannot flee from their own temper by going into the next room ; they must curb it or yield to it ; and in most cases they do control it, or we should have much more crime.

Many have to migrate from one district to another with frequency, because of the character of their work. They have not "steady jobs," and though they may not suffer from unemployment, they may be employed now in one part of the city, now in another. The result is that they have no abiding dwelling-place ; and as a rule have only the barest acquaintance with their neighbours ; for when people are moving about in this way they have neither the same opportunity nor the same desire to form friendships or acquaintances with those around them. Improvements in the means of locomotion have contributed to send employers and well-to-do people out of the crowded parts of the city. They see less of the lives of their workers than did a former generation ; and the bond between master and man becomes more and more a mere money bond. Each wants to get all he can out of the other. There is less of personal contact than there was, and more chance of mutual misunderstanding ; and with it all a general sense of irritability, instability, and insecurity.

Where men are crowded together, regulations are required for their health and comfort. Their liberty as individuals has to be restricted for the sake of health and peace ; and the more closely they are packed, the more interference is required. Practices which in the country might be harmless, or even laudable, would be intolerable if permitted in the town. To make our rules operative, we enact penalties against offenders—and sometimes enforce them. We have so many of them now, that it is questionable if there is a man in Glasgow who has not at one time or another broken some of them. The man from whose factory chimney black smoke issues, or who has obstructed the footpath by leaving goods outside his shop door, does not worry over, because he is not worried by, such laws. He may swear a little when summoned ; but he pays up if convicted, and says evil things about the officiousness of the sanitary and other authorities. It is a small matter to him. But the man who is proceeded against for using strange

oaths in public, or for spitting in or upon a car, has more worry over the business. He is not likely to be able to pay a fine with equanimity. We had our cars for a time disfigured with notices informing us how many persons had been dealt with for indulging in this filthy practice—thousands in a few months. One could not but admire or wonder at the zeal displayed in this matter, when it is quite obvious that far more injury is done to the health of the citizens by the smoke nuisance than by all the spitting we have taken such pains to confine to the street, or the hats of passers by.

Many of our laws are disobeyed because of ignorance or helplessness. There are very few men in Glasgow who could pass even an elementary examination on the laws of the city and the powers of the authorities ; but every now and then it is found that further powers are required ; and every extension implies an increase in the number of offences. I do not say that increased powers are not required, but if they are needed it must be because as a result of the growth of the city under existing conditions civic life is becoming more difficult. This suggests that it is not an organic growth ; but is growth by accretion of elements, not by absorption.

In the country and where people are not crowded together there are offenders against good government ; but there each one knows every other, and if a man commits a petty offence, though the local constable sees it he can be judiciously blind, if in his judgment that is the best course to take. He knows the inhabitants—they are his friends—and he reacts to the opinion of the district. If he makes an arrest the matter is discussed, and when the offender comes before the court, magistrate and prisoner do not meet as persons who do not know one another. Judgment is awarded on the knowledge not only of the offence but also of the offender, and all the parties in the case are tried by the public.

In the city it is not possible for the policeman to know the people who live in his district, nor for them to know him. He arrests a person he does not know for committing an offence. The prisoner is brought before a judge who knows neither of them, save officially, and judgment is given according to scale. As for informed public opinion, there is none. In the city as in the country, however, if an offender is known as being ordinarily a well-behaved man, he may not be prosecuted. If he is overcome by drink, someone may see him home or send him there. It is

not so much a question of his being well-to-do ; it is a question of his being known. If not known, no matter what his means, a man cannot be sent home in a cab ; but he may be sent to the police-station in a wheelbarrow. What else can the police do ? We take men of good physique and character, many of them country-bred and unacquainted with the complexities of city life. We pay them the wages of a labourer, and, with a uniform, invest them with powers and duties of the most varied kind. They must be able to keep people from offending, or to arrest if they do offend ; they must know the law ; they must be able to act as doctors on emergency—what must they not be prepared to do ? We multiply our complaints, and cast on their shoulders duties we ought to perform ourselves, blaming them not only for any blunders they may commit, but also for our own. We compel them to make arrests ; and then lament the result. For example :—A complaint is made to the police of the bad language used by girls at a street corner in a certain slum district. It is certainly lurid ; but where have they learnt it ? The decorative expressions complained of are part of the current vocabulary of the district, but are used with more restraint by the elders. We have all our pet adjectives. They differ in different localities, and are of the nature of slang. In the West-end a thing may be “awfully nice,” though nothing can be at once awful and nice. In the East-end the adjective is—well, quite as appropriate, but everybody knows its signification. So with other parts of speech. True, the language is filthy ; but it does not shock those who use it ; and that is perhaps the saddest thing about it. The girls are warned, but they persist in speaking their own language, and in bravado ornament it profusely and shout approbrious words at the policeman. One is caught. She has not necessarily been much worse than the others in her conduct, but has run in the wrong direction, or not fast enough to escape. She is taken to the police-station and again warned. The complaints persist. Again she is arrested. She is the bad one ; she was taken in the act before. She is sent to prison in default of paying a fine. On examination it is quite clear that she is just an ordinary slum-bred girl, with no special vice. She has been working ten hours a day, and at night wants some amusement. There is no play-ground for her but the street corner ; and she has been playing, in an objectionable way it is true, but how are we making it better ? In

essence it is a common story. The girl of whom I am speaking does not now work ten hours a day. She is brought to prison charged with other offences. What else could be expected? A term of imprisonment causes a girl to be shunned by her respectable neighbours. If they associate with her they may be taken to prison too. Indeed it is an offence to harbour or be an associate of some classes of offenders; but they must have company of some sort. The police could have done nothing else in the case; can as much be said for those of us who by persistent nagging force their hands, and who are more bent on punishing, than on mending, the bad manners of others? We have lost the personal interest we ought to have in our neighbours; we have gone out from among them; we have cast on officials duties we ought to undertake ourselves, as citizens, and the result is an increase in the number of offences and offenders. Serious crimes against the person are often a consequence of the lack of personal interest which prevents a stranger from checking the wild rage of a drunk man. Thieves and robbers find a hunting ground and a refuge in the crowded districts of a city where even next-door neighbours are strangers.

Crime is largely a by-product of our city life. It might be mitigated if we were more public-spirited; but it will always be a crying evil so long as we permit conditions to exist which shut men into tenements under circumstances that make decent communion and fellowship between them difficult, if not impossible; and compel them to remain there till they can pay a ransom to the man who holds up the land for his profit or his pleasure.

At present there is before Parliament a Bill for the Prevention of Crime, which is likely to become law. I do not propose to examine its provisions in detail, but I should like to direct attention to one point. I am most firmly convinced that the proposal to place "Habituals" under the control of officials in an institution until they are reported safe is bad; though I believe they should be placed under guardianship and observation. But let it be granted that it is desirable to do as the Bill proposes. The first object then is to keep within walls the dangerous and habitual criminals; but they are the persons who give most employment to the police; if you take them away and appoint others to look after them, what are you going to do with the police? I have not heard it suggested in any discussion of the measure, that

it is expected to result in a reduction of the Force, though the intention to employ more officials in the new institutions has been clearly indicated. But new criminals are being born? yes, and new policemen—only they are not born criminals and policemen: we make them. You will not have fewer officials, but more. When the criminals are put out of the way our policemen will have more time to look after the petty offenders, and the prisons will be as full as ever.

Of 1000 consecutive admissions to prison from Glasgow courts, 452 were born in Glasgow. I have no idea how many in the city are Glasgow born; but as it holds good of outlying towns that send their prisoners here, that a majority were not born in the town in which they committed their offence, I presume it is also the case with Glasgow. It is the stranger who is the bad one. The man bred in the city accommodates more easily to its conditions. He grows up among them and his life is rooted in them. He conforms to the dominant opinion of the social circle in which he moves, and is steadied thereby. If, as is generally the case, his companions are not ill-disposed, he is likely to be a peaceable citizen; if otherwise, he will get an impetus towards law-breaking. In any case he is of the soil, and his growth can the more easily be watched and checked. The immigrant is removed from the influences which unconsciously have directed his life; and new conditions may rapidly make or mar him. He has no one but himself to consult, and no inclination but his own to regard, and he tends to run loose. He is not more vicious or foolish than his town-bred brother; but he is not accustomed to the same temptations, and can neither resist them so well nor yield to them so gracefully. He is therefore more likely to succumb, and more likely to be found out. Men are attracted to the city by the hopes of pay and pleasure. In some respect we contrive to make it unattractive enough, one would think, but still they come. The only people who are absolutely certain not to come, and perforce to stay, are the men who have fixity of tenure and a home of their own. The others are as liable to lose their places as men in town; their work is hard and their pay small; they think their pleasures are few compared with the townsmen, and they gravitate to the city. But they are not only drawn in by the glitter, they are driven in by the drabness of country life, and sometimes by the clearance of men to make room for deer. Still the country keeps those who

have a home of their own. Their sons, who are landless men, enter the towns, but in times of depression they need not enter the ranks of the unemployed whom our distress committees have to help; they can return to their father's house, and work for their food there. Young people from the country are often greatly helped by the churches; but some are repelled, not because they dislike religion, but because they like occasionally to talk and think about something else. The County Benevolent Associations are powerful influences for good among immigrants; indeed they are so strong that it is sometimes very difficult for a Glasgow man to get a public appointment in Glasgow. The absence of family counsel and constraint which may cause a man's degradation, may cause his rise. He has to think and act for himself; and his freedom from ties enables him to attend more exclusively to his business, or pleasure. You have the immigrant largely represented in prison; but he is also largely represented in the Town Council—and the one place may be held to be as typical of the ill-doers as the other of the well-doers.

The older we get the less open our minds are to new impressions. In youth we are less experienced and less restrained in our views and actions. Rules of life as they are presented to many boys consist of a series of prohibitions, and they are not always the worst boys that kick against them. Wild boys are often quiet men; but if they are taken in hand by the penal machinery of the State there is not much chance for them. They imitate the showy vices of their elders, not because they are vices but because they are showy. They admire the wrong things no more frequently than grown-up people do, but they show their admiration in a way that is sometimes awkward both for them and for us. They read vile papers, and we often give them books that are worse; since they glorify the meaner virtues in the interests of smugness and selfishness. Occasionally we see that some one has been taken with a mask and pistol in his possession, attempting to rob on the highway. Then we have homilies on pernicious literature of the "Dick Turpin" kind from people who have interests in, or are readers of, newspapers written with as little conscience; and which engender enmity, and provoke war, among the nations. There are thousands of men who, as boys, have read prohibited "Bloods" and enjoyed them; but they do not spend much time on the sensational publications which circulate in millions among adults now-a-days.

The boy's "Dick Turpin" is not ours. The hero is a hero to him because he dares against odds, and dies with a brave heart. He is a poor boy who has not his day-dreams. He plays at being a hero; but if his play interferes with us we may make him a criminal. Instead of sending him to some one who would try to understand him and teach him to take his play less seriously, we send him to a goal. Much of the mischief done by boys is the outcome of their love of adventure. They may do cruel things and wicked things, but we can only prevent them by wise teaching; and that involves making an effort to obtain their confidence and to appreciate their standpoint. Our punishments are as likely to knock evil into the boy as to knock it out of him; and our substitute-heroes do not appeal to him because he is less sophisticated than we are. There is no comparison between his highwayman—a boy's highwayman, who robbed the rich and gave to the poor, to the inversion of all social order—and the industrious apprentice who married his master's daughter—poor girl. The one takes all risks and holds his life and comfort cheap, so he can be true to his friends and his honour. The other takes no risks and seizes every advantage to "get on." The boy who makes him his hero is in a bad way—or the man. We know it is all wrong. That kind of "Dick Turpin" or "Robin Hood" never existed; but that is how the boy's fancy paints him. What we see is, that the "Blood" is a glorification of a particular kind of theft. We forget that there is no likelihood of its ever coming into vogue again. Dick Turpin is now a company promoter, and his cheques are in demand by churches and political parties. He does not risk his life now; and we are very glad to be taken into his confidence. But the boy does not see that; even though the thing is the wrong thing, he sees it is done in the right way. It is a pity that in dealing with bad boys, so many of us forget we were bad boys; though we are now such good men. The boy's susceptibility to impressions, his high spirits and his inexperience of life, tend to cause his transgressions. In the city we have no adequate provision for boys to have recreation. They play football in the streets because they have no other place where they can play. If they persist we deal with them summarily. Some of them steal to get to entertainments; then we send them to reformatories. They have become too great a nuisance. There they have opportunities for recreation which were denied them before they stole, but as a compensation

they have the prospect of leaving the place with the stigma that residence there entails ; and meantime they can compare notes of past wrong-doing with their fellows there. The street is the city boy's playground. In his hobbledehoy stage he forms companionships at street corners. One stimulates another to mischief. It is a game without rules. The crowd will do what the individual would shrink from ; and the lad in company of others does things he would not think of doing alone. Then we have an outbreak of "Hooliganism," worse in its effects perhaps, but like in its inception to a students' row. The evil elements in the district then shield themselves behind the mischievous but not ill-disposed, and, under cover of their support, commit ravages. Being now accomplices, many may be drawn in to commit acts of dishonesty and outrage themselves ; and the loose cohesion between the parties becomes organised. To break it down on rational lines, the obvious way is to bring pressure to bear on the parents and employers of the lads to exert personal influence on, and induce, the better disposed to separate themselves ; when the deliberate offenders, finding themselves likely to be more prominent than safe, disappear as is their manner. Each time of life has its dangers and temptations, but a fall at the beginning is more easy, and is often more fatal to future well-doing.

Fewer women than men transgress the laws. In spite of recent occurrences, I think the majority of them are less venturesome than men. When they do fall under the lash of the law, it is much more difficult for them to recover ; but there is no evidence, so far as I have seen, that this is due to the inherent difference of sex : it appears rather to be due to the different social position of women. They are much harder on one another than they are on men ; or than men are, either on their own sex or on women. Their sex, however, does subject them to temptations special to them, which I cannot discuss here. For the same work they are paid lower wages than men, but this is really due to lack of organisation among them. It has been stated that the smallness of their wages is a common cause of women selling themselves, but I have not found this to be the case to any extent. So far as I have seen it is as rare an occurrence for an ordinary woman to barter her honour for bread, as it is for an ordinary man to steal because he is out of work. The daughters of the well-to-do, working side by side with girls who have to earn their living, set up a standard of

dress and comfort which causes a good deal of evil among the younger, weaker, and more vain, of their poorer neighbours. Women are as vain as men ; and they have as petty ambitions in their own way. To obtain dress thefts have been committed ; and I have known many women whose fall was occasioned by a desire to procure money for this purpose.

Our social inequalities are the cause of much serious crime. The great disparity between the position of the very poor and the very rich, results in envy, discontent and all uncharitableness. Men want to "get on ;" and with this object in view they do things they would condemn in others. As many spend more time in intriguing to get a position they cannot fill, than would enable them to qualify for it, so many spend their existence making money or position, instead of living. They mean to do great things and kind when their ships come home ; and they do not realise that the question for each of us is, not what we would do if we had what we desire ; but, what we are doing, being what we are, and where we are. In the thirst for wealth dishonest practices are condoned in business. In the worship of material success, what a man *is*, hardly counts in view of what he *has*. This cannot but have a vicious effect. Young men pilfer to make a show. Older men betray their trusts to gamble in stocks. Churches run lotteries for gain, as though the end justified the means. Newspapers organise sweepstakes under the thinnest disguise. Workmen and women pore over the betting news and run into debt to back a horse. No : it is not in many cases the desire for harmless and cheap excitement that stirs them ; it is simply greed, and the ambition to stand higher socially than their neighbour—as though a high position in a society with such a basis were any honour to a man. But society does not rest on such a basis. If it did it would not stand long. The great mass of all classes have little part in such folly. Most of our fellow-citizens live their own lives quietly, and discharge their duties according to their own light and their ability. But these social inequalities provoke, and false ideals stimulate, many to the commission of crime ; and because of that it is necessary to remind ourselves and others that ultimately a man is judged not by what he has, but by what he is : and to refuse to bow down and worship, though we should never "get on."

My business here to-night is not to discuss some remedies for, but some causes of, crime ; to diagnose conditions, not to prescribe

cures ; but I may be permitted to indicate broadly the direction in which reform lies. The conditions which cause crime may to a large extent be modified by political action. Crime is largely a concomitant of city life, as we have it. We need more room. So long as we permit such congestion as exists, anything we do can at best palliate. We may regulate the sale of drink with a view to diminishing drunkenness ; we may classify our poor and attempt to relieve their poverty ; but drink, and poverty, and all the other causes, have only power to produce crime, according to the degree in which we permit men to be packed together. Let our cities continue to be hemmed in and built in the air instead of on the earth, and we shall require additional sanitary and police regulations, and will have an increased number to support in institutions. In an industrial community the city is said to be a necessity ; but surely not the city as we have it. Men could live near each other, and work at the same occupation, at least as efficiently if they had room, as they do under the cramping conditions that exist. Reform your cities ; or rather see that men are not allowed, for their private profit or pleasure, to “do what they like with their own,” in defiance of the public interest—and the cities will reform themselves. There is no reason other than the protection of vested interests for the crowding of people in the cities and the depopulation of the country. There is no other reason why, when a license is given for the sale of drink, such conditions should not from time to time be made as would tend to prevent a good deal of drunkenness and disorder. There is no other reason why owners of house property should not be compelled to assume its supervision and that of their tenants, as some good landlords do, and so let light in on the “knights of industry” who are hidden in our great towns.

But political action is slow, and political parties are—what they are. To most of us a change of government means that Lord Dash is replaced by the Rt. Hon. Mr Blank—probably relatives, and almost invariably belonging to the same caste. When it comes to doing things instead of talking about them, more depends on sentimental impressions, the result of friendly contact, than on intellectual differences and political theories. With infinite bustle and labour we send members to Parliament. When they go there they find the government is formed. There are men in position for whom they would never have voted ; but

they are of the right colour ; and the duty of an M.P. is to vote as the whips tell him, on pain of endangering the party. If it ever occurs to him, it does not seem to strike his constituents, that the "Party" does not necessarily mean the government formed, not by, but in name of, the party. By-and-bye he finds himself out, because to save the party as represented by the whips, he has voted in a way displeasing to the party that put him in. Then the other side gets a chance, and so on *ad infinitum* ; till one is struck by the "Hereditary genius" of some families in obtaining offices—Statesmanship—or the hereditary stupidity of the mass of the electors in not seeing that they have not even the form of representative government, so far as Parliament is concerned. More and more the real power—the power of administration—is passing into the hands of the permanent officials, and less and less control is exercised over them by Parliament. This is not the place or the occasion to discuss that aspect of affairs, but it is necessary to call attention to it, since, whatever their virtues, they have seldom shown ability to keep in touch with public needs and public sentiment.

Parliament may fail to attack and rout those whose interest is opposed to the alteration of existing laws ; but there are things which we can do as citizens without asking Parliament, which would mitigate existing evils. We can encourage our officials to aim at preventing wrong-doing rather than at punishing the wrong-doer. We can set about to see that more opportunities of reasonable recreation are provided, and to find out wherein and why our present provision has failed. Those of us who are employers can take a greater personal interest in our workpeople ; and if we try to learn from them we may be able to teach them. Our church members might easily come more closely in contact with some less fortunate member of the congregation, and give kindly aid and counsel ; or receive it, perhaps, where they would least expect it. All of us would see, if we looked a little less to our own business and pleasure, that there are many around us whose struggle is a sore one, and whom a friendly interest would help. Many there are who, though neither able to pay nor pray, could by personal service do much good and gain much. It will help, as nothing else can, to a better understanding between us and our neighbours, and a more acute apprehension of the evil surroundings in which so many are compelled to live. Men go wrong and keep wrong

because of lack of good fellowship. The conditions which are most harmful are bad because they hinder the fraternising of man with man. We are crowded together, struggling "to get on"—to get out of the welter—and we have comparatively little interest in others. I know there are many good people who are interested in the poor and fallen, but they are trying to make men conform to their ideal—a different thing altogether from interest in the man for his own sake. Most of us feel that we have not been so brilliantly successful in directing our own lives that we are justified in directing those of others; but by interest in such as are having a harder struggle to live than has fallen to our lot, we may not only encourage the individual to better effort but we shall see more clearly what needs to be done by us as a community, not to make men, but to remove those conditions which tend to enslave them.

A Zoological Expedition to South America.

By W. E. AGAR, M.A.

[Read before the Society, 13th January, 1909.]

OF all the regions into which the world is divided by zoologists in accordance with their faunas, by far the most interesting is that comprising South America. The sportsman in search of big game goes to Africa, where he meets enormous herds of that perhaps most highly specialised and successful of all the orders of mammalia, the ungulates or hoofed animals, and is able to take his part in the extermination of the antelopes, giraffes, rhinoceroses, zebras, hippopotamus and elephants. These forms, however, so characteristic of the African continent for the very reason that they belong to a highly specialised group, are of no special interest to the zoologist. If we turn to South America we find a very different state of things. Instead of great herds of ungulates, we find there only four families of them represented. The pigs are represented by the peccary, the cervidae by a few species of deer, the camels by the llama, and finally there is the tapir, while the beasts which we may call *characteristic* of the country are such forms as the opossum, armadillo, ant-eater and sloth, all very lowly organised mammals.

Our interest in the South American fauna is deepened, and becomes a more intelligent one when we examine its history in past geological ages.

The past history of the mammals shows us that broadly speaking most new forms arose in the North Polar regions (which we know were much warmer then than now) and spread thence southwards, exterminating to a large extent the more primitive earlier forms, and being sometimes ousted in their turn by new forms migrating southwards. Now the primitive mammals which arose in the Northern Hemisphere seem to have reached South America, not across the Isthmus of Panama for we know that the whole South portion of North America was submerged at this period, but probably by means of a land connection across the Atlantic with

Africa. Whatever may have been the exact nature of this connection between South America and the other land masses of the globe towards the end of the secondary Geological epoch, it is certain that it was soon broken through and that South America was completely isolated during the whole of that period in which the most active evolution of mammalia was taking place in other parts of the world. The few low mammals which had got into South America before it became isolated evolved a very peculiar mammalian fauna, including such forms as the giant sloth or *Megatherium*, and glyptodonts like gigantic armadillos, which, however, never reached a very high grade of development, such as the mammals in the more desperate struggle for existence that was going on in other parts of the world were attaining.

During the end of the Miocene period the emergence of the Isthmus of Panama allowed the influx of the more highly specialised forms from the Northern Hemisphere, and completely changed the character of the South American fauna. In fossiliferous beds after this, though they had been conspicuously absent before, we find lions, the sabre-toothed tiger, dogs, bears, llama, deer, horses, tapirs and peccaries, appearing now for the first time in South America, though they had been abundant in other parts of the globe for ages before. These new forms established themselves to a great extent at the expense of the old typical South American fauna. Remains of this original fauna however still survive in the opossum, armadillo, ant-eater and sloths, while the new forms, which are now far more abundant, both in numbers and species, include such forms as the deer, tapir, peccary, puma, jaguar, wild cats, dogs, etc.

The mammals are not the only animals which are represented in South America by lowly forms. The animal in which I was most interested was a fish. In ancient geological ages a group of fishes called the Dipnoi were the dominant group. They have left their fossil remains all over the world. At the present day, as has happened in so many cases with formerly important and cosmopolitan groups of mammals, they now survive only in the three most southern of the mainland masses of the world—I refer to the lungfishes, of which one survives in Queensland, one in Africa, and the third in South America. The South American lungfish, *Lepidosiren*, besides its interest from its position in the animal kingdom, forming as it does a sort of connecting link between

fishes and terrestrial vertebrates, happens to afford probably the most favourable material of all vertebrates for determining certain problems of the microscopical structure of living animals, and it was mainly to get this material, appropriately preserved, that I went out to South America.

It must not be supposed, however, that the presence of these primitive forms is the only attraction this continent has to offer to the naturalist. Probably nowhere in the world is there such a profusion of strange and beautiful birds and insects.

My goal was one of the stations of the South American Missionary Society, very near where Professor Graham Kerr obtained the material for his well-known work on the embryology of *Lepidosiren*.

The station is situated in the Gran Chaco of Paraguay, which occupies the whole of Paraguay west of the river. To get there one goes to Buenos Aires, and there embarks on one of the river steamers which ply up and down the Parana and Paraguay. A journey of six days, about a thousand miles, brings one to Asuncion, the capital of Paraguay. Here it is necessary to change into a smaller boat, and two nights and a day bring one to the little town of Villa Concepcion. Already one has noticed the different aspects of the two sides of the river. On the east is the more or less settled and civilised, and often hilly land of Paraguay proper, on the west is the vast level plain of the Chaco, which except for a few cattle estancias near the river, and a dozen English missionaries in the interior, is inhabited solely by scarce bands of roving Indians.

Having arrived at Villa Concepcion with one of the missionaries with whom I was to make my headquarters, it only remained to be rowed across the river to land on the west bank in Indian territory at once. Here we were met by other missionaries with Indians and bullock waggons, and in a day or two we started off on our journey of nearly a hundred miles to the most western of the three mission stations which have been established in the Chaco.

It is not long before one feels that one knows the Chaco scenery pretty well. El Gran Chaco is a great level plain, the northern continuation of the Pampas of Argentina. Geologically it is composed of very fine alluvial mud, which has doubtless been gradually swept down by the rivers and swamps which drain away from the high ground, culminating in the Andes, in the

west. The Chaco rivers all run in this direction, from west to east, draining into the river Paraguay, and a very slow movement in the same direction can be detected in the waters of the swamps. Not a pebble is to be found for hundreds of square miles, and the extreme fineness of the soil makes it difficult for water to drain away, so that every heavy shower of rain puts the greater part of the place under water.

The greater part of the open country consists of "Palmar." This is flat meadow land, covered with knee-deep grasses and dotted over with fan palms (*Copernicia cerifera*). These are set at varying distances, sometimes as close as firs in a fir wood, more often much more widely separated. Although this country has a great beauty of its own, it soon gets exceedingly monotonous to travel in. The flatness of the ground, and the palm trees scattered over it combine to limit one's view to a very narrow circumference. The bullock waggons toil along at three miles an hour or less, and nothing happens to enliven the journey except an occasional disaster to a waggon, such as a jamb on a palm stump, or an upset over an ant hill—a break in the monotony which is by no means welcome if the said cart is packed with collecting apparatus. Even conversation, should one feel energetic enough to desire it after hours of travel through a blazing tropical sun, is a practical impossibility, as nothing will induce the Indian-trained horses to travel in any other fashion than in single file. The little buttons of shade cast on the ground from the palm tops far overhead are not close nor dense enough to afford any relief from the sun, and altogether it is with unmitigated relief that one hears that one of the recognised halting places is in sight.

Other trees beside palms are met with in the open country. Occasional groves of a leguminous tree bearing an edible fruit—the algarroba (*Prosopis*)—are met with, and here and there patches of quebracho (*Loxopterygium*) break the monotony.

Scattered about in the open camp are patches of dense forest or "Monte." These forests do not altogether conform to one's preconceived ideas of the virgin tropical forest, obtained from reading the descriptions of travellers in countries with a larger and more regular rainfall. They partake mostly of the nature of immense thickets, the majority of the trees being quite low. It is needless to say that with waggons one skirts the montes rather than tries to penetrate them, which indeed is a difficult task for a

man on foot. Every bush and tree seems set with sharp thorns, and the dense undergrowth consists chiefly of thorny plants. Conspicuous among them are the bromelias, whose blade-like leaves are set with sharp curved hooks. Spiney cactuses also form part of the undergrowth, especially near the edges of the forest. In compensation for their thorns they produce the most showy flowers of the Chaco. Thick leather leggings, and an abundant supply of breeches are indispensable to any one who wants to do any exploration in the montes. Another absolutely necessary article is a compass, as I had abundant proof myself. One is certain to lose one's sense of direction after creeping only forty or fifty yards into the maze of trees, creepers and undergrowth, and many a time when there was no sun to guide me I should have had no idea in which direction home lay had I not had a compass with me.

Although so unpleasant under foot, the bromelias are the salvation of the traveller in the Chaco in the dry season. The rosette formed by the bases of the leaves collects the rain and retains it long after all the pools are dried up, and it is frequently the only source from which to obtain any water to drink.

In the forests, and the palmar fringing them, one comes across the little forest deer and the peccary, while monkeys may be heard screaming in the trees. The carpincho or capybara, which is the largest of the rodents—imagine a guinea-pig as big as a collie dog—is to be found along the forest-clad banks of the streams, and here also the tracks of the jaguar are frequent, and one may make sure of seeing one bound away into the undergrowth if one keeps one's eyes open whilst riding along the edge of the thicket. The puma, or South American lion, I was never lucky enough to see, although it occurs in this country.

The modern remnants of the original South American mammalian fauna which flourished unchallenged before the immigration of the more pushful ungulates and carnivora which now form the more conspicuous part of the mammalian fauna, are here in the forest, but they are all retiring creatures and need looking for. Naturally, however, it is they that interest the zoologist chiefly. Indeed the collection of embryological material of certain forms of them, which has never before been obtained, was one of the specific objects of this expedition, and native hunters were employed to collect them. The little mouse opossum (*Didelphys*

pusilla), one of the marsupials, is one of these animals. It is a nocturnal creature, a size larger than a mouse, with enormous black eyes, fan-like ears and long prehensile tail. It lives squirrel-like among the trees.

Then the armadillos, relations of the gigantic extinct megatherium and Glyptodonts live among the undergrowth in these forests. They are abundant both in numbers and species, but very difficult to see. The Indians catch them alive by following up their tracks into their burrows. I was able to collect a fair number of specimens belonging to three different genera.

The other members of the ancient fauna which linger on in the forests of the Paraguayan Chaco are the ant-eaters. These are rarely met with, and rewards, huge in their eyes, were offered to the Indians for specimens. Our efforts resulted in the capture of two specimens of *Myrmecophaga*, the great ant-eater. Surely no living mammal presents such a weird appearance as does this beast. It is a large animal, fully 7 feet long, counting the long tail, which is carried horizontally and covered with a long thick mane, having the effect of making the animal appear much larger than it really is. The snout is enormously prolonged, ending in a very small mouth through which the long tongue can be protruded. The claws of the front legs are very long and strong, and the legs themselves provided with huge muscles, for the purpose of tearing open the ant hills. Moreover, the beast is strongly bandy-legged, so that it shuffles along on the sides of its fore paws, the palms of the hands turned inwards. In consequence of this the animal is only capable of a very clumsy shuffling gait, and could have no hope of escaping an enemy by flight. The herculean front legs with their terrible claws, however, are all that are required as defensive weapons, and with these it can rip open a dog before it has a chance to get its teeth through its bristly hair and tough skin. It is even said, though I do not know on what evidence, that it is a match for the jaguar.

The Indians themselves regard the ant-eater as a great rarity, and there was much excitement over the first of the two specimens. We got it about sunset, and myself and a missionary friend set to work to skin and dissect it by the light of a big fire, started to the windward of us for the double purpose of giving us light and keeping away the mosquitoes, while all the Indians of the village squatted round discussing the event in short ejaculatory sentences,

passing the solitary pipe round and round the ring as is their custom. As soon as the carcass was freed from the skin it was borne away by the Indians and all vanished to join in the feast.

We have not yet mentioned the third great feature of the Chaco landscape, the swamps which cover hundreds of square miles. In the dry season these are merely dry dusty plains, but when the wet season comes, which usually lasts from about October to March, they become filled with water to a depth varying with the amount of rain there has been, but not often more than about four feet. The alternation of wet and dry seasons is not quite regular. The summer before I went out the wet season had been omitted, and the country was suffering from a severe drought. On our journey to the mission station we had difficulty in getting water to drink. Five months later, not only were the swamps themselves full and almost impassible, but most of the palmar itself was under water too. When we were making the return journey from the mission station to the river, out of the first forty miles there were only two short stretches, together not totalling half a mile, in which we were not riding through standing water.

It will be understood that travelling with bullock waggons is not very pleasant under these conditions. Although the carts are set on very high wheels to guard against this contingency, they not infrequently sink in the mud up to their axles and become stuck. It is nothing out of the way to spend a week getting a cart twenty or thirty miles in flood time.

In spite of the vast areas of land completely submerged in the rainy season, one never gets the sight of a sheet of water. In the dry season the swamps are mere plains covered with short grass. Directly the rains come and the water begins to stand about, the weeds spring up with astonishing quickness, and where three months ago there was short parched up grass, in the deeper parts of the swamp there will now be perhaps four feet of water and a growth of grasses and papyrus matted together with convolvulus and other creeping plants, far higher than a man's head and so dense that one has difficulty in fighting one's way through it.

These swamps are the homes of millions of wild fowl. There are flocks of ducks of various species in such countless numbers that the noise of them striking their wings on the water as they rise into the air often deceives the new-comer into thinking he hears a distant roll of thunder. Storks and herons are there in

plenty, the great chajá (*Palamedea*) with its piercing scream, and the jacana, a bird not unlike a very small moorhen, of a bright chestnut colour with lemon-coloured underwings. It has very long toes which enable it to run over the surface of the floating weeds without sinking in. They go about in small flocks, and have a beautiful habit of suddenly raising their wings so as to expose the yellow undersurface for a few seconds. Ibises are there in great numbers too, and many other peculiar birds, some of great size, rise up before one with great flapping of wings as one pushes one's way laboriously through the tall weeds.

Of all the denizens of the swamps the most interesting to the naturalist is of course the lungfish or *Lepidosiren*. Although specimens of these have always been great rarities in museums, at anyrate prior to Professor Kerr's expedition, they are extremely abundant in the Chaco swamps, in fact, they form a very important part of the natives' food supply.

During the wet season, when the swamps are full, the lungfish lives like a fish in the water—unlike an ordinary fish, however, in that it has to rise to the surface to breathe now and then, for its gills are reduced and incapable of extracting sufficient oxygen out of the water. In compensation for this, it possesses, as its name implies, a pair of typical lungs, by means of which it can breathe air. During this period the fish are captured by the Indians by spearing.

The thick weeds and reddish colour of the water make it quite impossible to see the fish, but they often betray themselves by causing a quiver in the reeds as they swim past showing the hunter where to strike. A full-grown female is over 3 feet long, and as it is pretty thick too, it presents a fair-sized target. More often they spear the male as it lies in its nest guarding its young.

When the swamps dry up, the lungfish makes a burrow for itself in the soft mud, and lies in it with its tail curled up over its head. The burrow communicates with the air by a narrow opening. At first the fish lies close beneath the surface, but as the upper layers of mud dry up it deepens its burrow, so that it is always found in a stratum of fairly moist mud.

In this burrow the fish has to lie till the swamps are again filled next rainy season. As this season is in some years missed out, it has to be prepared to last at least eighteen months without food. It makes ready for this fast by eating much more than it requires

during the wet season, and storing up the surplus as fat, especially in the tail. During the dry season this fat is slowly re-absorbed. The chief food of the lungfish is a water snail, *Ampullaria*.

It was curious to think as one walked over the parched plains which represent the swamps in the dry season, that a few feet below that baked up surface were thousands of living fish. And the lungfish is not the only possessor of this interesting habit, but a kind of eel, *Symbranchus*, passes the dry season in much the same way, and I saw some Indians who were engaged in digging a well, bring out several live specimens from some feet below the surface.

During the dry season the Indians dig the lungfish out of the ground with sharp wooden stakes, the little breathing hole at the top of the burrow betraying it at once.

Most of my efforts were directed towards finding nests of the lungfish, as the material required consisted mainly of breeding males and developing eggs. The nest of the *Lepidosiren* consists of a tunnel slanting obliquely downwards in the mud at the bottom of the swamp, and roughly lined with fragments of water weeds. After she has laid her eggs the female swims away and takes no more thought for the future of her progeny. Not so the male, however. The eggs are placed at the end of the burrow, and the male lies in the passage leading to it, ready to defend his home with his powerful teeth—as I proved unintentionally on my own person, by putting my hand into a burrow from which I thought the male had been driven out. I quickly drew it out again with my little finger cut open.

The devotion of the male lungfish is truly admirable, for he stays in the nest the whole time, from the moment the eggs are laid till the young are ready to leave the nest, a period of about seven weeks.

Lepidosiren nests are very abundant, and easy to find when the water is not too deep. I used generally to go out into the swamp soon after day-break with one or two Indians, armed with their long thin fish spears. On reaching a suitable part of the swamp they would proceed to prod the ground at the roots of likely-looking clumps of papyrus, among the roots of which most of the nests are situated. The nests are discovered by the simple but sure way of feeling the transfixed *Lepidosiren* wriggling on the end of the spear.

Curiously enough there is another fish in these swamps which has very similar nesting habits to the lungfish. I refer to the eel mentioned before as being able to pass the dry season in the mud like *Lepidosiren*. In this species the nests are also burrows in the mud, though not lined with water weeds, and the male keeps guard over the developing eggs.

The two classes of animals which force themselves most upon the notice of a new-comer in the Chaco, be he naturalist or no, have not yet been referred to. These are the frogs and the insects. At home the common frog and toad exhaust the species of this class of animal with which one is likely to meet, and one thinks of them as retiring animals, and not often seen and seldom heard. In a wet net in the Chaco the noise made by the frogs is deafening. There are about four and twenty species of them, and each one seems to have a distinctive cry of its own. Some of them have curious breeding habits. One species lays its eggs immediately after a shower of rain in quite temporary pools. These eggs go through their development very quickly, hatching within twenty-four hours after they are laid. Some of the climbing tree frogs are very handsome and make most interesting nests, suspended from bushes overhanging pools. In one case (*Phyllomedusa saurvaçii*), when the frog is about to lay its eggs it crawls out on to a suitable branch, and pulling a number of leaves together proceeds to cement them in this position by means of a plug of jelly, formed by a mass of gelatinous egg cases which are laid without any eggs in them. The plug so made forms the floor of the nest, the leaves to which it is stuck the sides; the eggs are then laid into the chamber so formed, and finally another jelly plug is added as a roof to the whole structure. If such a nest is opened at the right time it is found to be full of a seething mass of little tadpoles, wriggling about in a sort of soup formed by the liquefaction of the gelatinous egg cases, the whole held in position by the plug at the bottom. This plug gradually softens under the influence of the fluid above it, and if a nest in this condition is watched, one presently sees a thick viscid drop forming, and soon this falls off into the water of the pool beneath, perhaps carrying with it a tadpole. Soon another drop forms, then they come more quickly, and now the whole semi-fluid contents of the nest are falling in a steady drip into the water, each drop carrying with it a number of wriggling tadpoles. In one nest in which I

watched the whole process from start to finish, over three hundred tadpoles fell out of the nest into the water beneath in forty-five minutes.

Of the insects, the locusts, ants and mosquitoes are perhaps the most striking. A swarm of locusts is a marvellous sight. At first one sees apparently a long dark cloud of a peculiar reddish colour appearing above the horizon, and if it is one's first experience one thinks one is in for a storm. However, in an hour or so the cloud is overhead, and has resolved itself into countless millions of locusts, so that the sky is darkened with them and the air full of the whirring of their wings. They settle on the trees, and in a few hours entirely strip them of leaves.

There are many different species of ant, the most remarkable perhaps being the saüba or leaf-cutting ant. As one goes through the forest one will frequently come across what looks like a column of small leaves on the march. Closer examination shows that this appearance is caused by two columns of ants hurrying along a well-beaten track. Every ant going in the one direction is carrying upright in its jaws a circular piece of leaf about as large as a sixpence, while all the ants going in the other direction are empty-handed. If we follow up this path in the direction in which the empty-handed ants are going we come at last—though not for seventy or eighty yards—to a tree at which it stops. At the foot of the tree one sees a thick pile of little circular pieces of leaf such as the ants are carrying, and it is evident that they are going backwards and forwards from the nest, bearing off these leafy discs. Up in the tree one sees other ants of the same species busy cutting out new pieces of leaf, which fall in quite a continuous shower to the ground beneath. If we follow up the ant's path in the other direction we see it lead into a great low mound, the largest being thirty or forty yards in circumference and two feet high. This immense mound is formed entirely by minute granules of earth brought up from the enormous system of underground passages of the ant. Numerous other paths lead into it, the main roads branching out in all directions, each branch ending at last at the foot of a tree. All the paths are trodden quite hard and smooth by the millions of little feet, and they look like cart-wheel tracks.

It is now known that the saüba ant takes the fragments of leaves which it collects in this way into its subterranean nest

and uses them to grow a fungus on which provides food for the ant.

This ant seems to work by night as well as by day, at least I have seen them by the light of a lantern several hours after sunset, just as busy as during the daytime.

The other insects mentioned, the mosquitoes, are quite indescribable. They are indeed the most important of all the circumstances which condition one's daily life in the Chaco. If the mosquitoes are quiet, life is enjoyable. If they are bad, it is not worth living after sunset. Their numbers and vindictiveness are almost incredible. Personal experience is necessary to convince one how easily they can and do get through a flannel coat and shirt. If one goes out anywhere after dark, or in swampy places even in the daytime, one's shoulders are riddled with their bites, and the same with every part of the body where one's clothes touch one—and as to one's hands and face, who can describe the misery of it? Horses suffer terribly too, and at the end of the summer there is scarcely one in ten fit to be ridden. If when travelling at night one seeks to encourage one's dejected horse with a pat on the neck, one finds one's hand covered with blood squashed out of the bodies of gorged mosquitoes packed almost as closely as there is room for them.

The area of the Paraguayan Chaco is 72,000 square miles, and the population about 30,000, according to the missionaries' estimates. These 30,000 natives are divided among several distinct tribes, speaking different languages. The largest of the tribes is the Lenguas, who number about 10,000.

They possess the general features characteristic of the natives of the whole American continent, copper-coloured complexions, straight black hair, high cheek bones and rather thick lips. They have very little hair on the faces and bodies, and what they have they rigorously pluck out by the roots—even removing in this way their eyebrows and eyelashes.

The men wear a blanket reaching from the waist to the knees, and the women a similar garment of deerskin. Both sexes ornament themselves with necklaces and anklets, and paint straight lines on their faces with a red or black dye. Head-dresses of feathers are worn on dress occasions. The native weapons are the bow and arrow, and the club. They make dug-out canoes from the bottle trunk tree (*Bombax ventricosa*).

Fire is produced by drilling one stick into a notch cut in another.

The Lenguas have no settled dwelling places, but wander about in small parties, building temporary villages or "toldos" where they stay for a few weeks till the game in the neighbourhood is exhausted, when they move on somewhere else. They are very likeable people, and one soon becomes great friends with them. They are on extremely good terms with the missionaries, and hence anyone passing as the guest of the latter is sure of good treatment at their hands. Travelling in the Chaco one falls naturally into terms of friendly equality with the natives, except for that authority which is inseparable from the possession of superior knowledge and appliances—a very different relation to that which naturally arises between a European and the African native, to judge from the accounts of explorers in that continent.

Some Considerations on Scottish Universities, with Special Reference to Needed Reforms. By R. F. MUIRHEAD, B.A., D.Sc. •

[Read before the Society, 24th February, 1909.]

Introduction.

THE University of Glasgow, like the other universities of Scotland, is passing through a period of growth and change. The Universities' Commission of 1889 (the outcome of the movement for reform that became active about half a dozen years earlier), was occupied up till 1897 in issuing new Ordinances for the regulation of university affairs, and scarcely more than a year ago the Court exercised its power in making a new Ordinance involving further important changes. It is, I think, fairly obvious that the period of change has not yet ceased, and I think no one who has the welfare of the University at heart, and who is well acquainted with its present condition would desire the cessation of reform until considerable improvements have been effected.

The time is, then, opportune for the consideration of the present state and future prospects and possibilities of the University by a Society like ours which aims at being a focus for the intelligence and wisdom of the inhabitants of this city, and which can furnish, and from time to time has furnished an arena for serious and yet free and unprejudiced discussion of matters of practical and theoretic interest.

It is with the hope of demonstrating the urgency of the problem to the members of this Society and others whom my words will reach, that I have undertaken to-night to address to you "*Some Considerations on Scottish Universities, with Special Reference to Needed Reforms.*"

Scope of the Paper.

I do not propose to give you a paper of archæological research : my references to the history of our universities will be brief. Nor shall I attempt to give a complete survey of the present state of all our universities, or even of one of them. I must take for

granted, to a great extent, your knowledge of what exists, for I wish to occupy the time at my disposal mainly in bringing into clear relief certain features of our universities which I believe could be amended, and in pointing out how the amendment might be brought about. And though my observations upon these topics will mostly have application to all the Scottish Universities, yet they will have most directly in view our own University of Glasgow.

Now I hope no one will suppose me to be blind to the many merits of our University as it now is or has been, if the practical aim of this communication leads me to dwell more on its deformities than on its graces. And I hope it will be possible for me to give utterance to some sharp criticisms of things as they are, by constitution or traditional practice, without being supposed to cast reflections on the present members of the staff, who form a body of workers of which any university might be proud, and among whom are to be found individuals whose efforts and achievements on behalf of education and research deserve warm recognition.

Function of a University.

To criticise an institution implies in the critic the perception of an ideal not realized by the institution criticised, and the critic may be called on to formulate his ideal. It is, I think, pretty generally agreed that a modern Scottish University ought to serve several related purposes. It should serve as a training school for the learned professions, it should transmit liberal education and culture to the rising generation, and it should be a place where the search after truth, and the building up of deeper and wider knowledge should be actively carried on. Opinions will differ as to the best methods for attaining these objects, both in general, and in particular cases, yet if it be but granted that one of the chief tasks of the University is *to bring into touch, under favourable circumstances, with as little of unnecessary restriction as possible, the able and willing teacher and the able and willing learner*, it will not be difficult to draw from that admission very important conclusions.

Let us glance for a moment at the rise of modern universities, and the early and recent history of the University of Glasgow.

Rise of Universities in Europe.

The University of Bologna in the 12th century drew crowds of students from every country in Christendom. Its constitution was at first a loose and informal one. Teachers and students drew together by a natural attraction (as they always will do when there is opportunity) and the organization into "Nations" with their rector; and faculties, with their bachelors, masters, doctors, professors, etc., gradually grew up, and was followed by the formation of colleges. Other universities arose in Italy about the same time, and the Italian universities served as models to those that sprang up all over civilized Europe.

It is somewhat significant, however, that (according to a historian) "the intellectual life of Italy was mainly outside its universities" at the time when the University of Glasgow was founded after the pattern of Bologna. The best of human institutions is prone to grow old and infirm, when not periodically rejuvenated. Perhaps it is unreasonable to expect an institution to preserve its vigour intact longer than the generation which founded it.

Early History of the University of Glasgow.

Let us turn to the current "Calendar" for a brief description of the University of Glasgow at its commencement.

"The University of Glasgow is a corporate body which has always included a Chancellor, Rector, Dean of Faculties, Principal, Professors, and Students. . . . Pope Nicholas V., by a bull, dated the seventh of January, 1450-1, erects and establishes in Glasgow a *Studium Generale*. . . . The University, at this time, had received no endowments, and was possessed of no property, except a university purse, into which were put some small perquisites on conferring degrees, and the patronage of two or three small chaplainies. It continued, however, to discharge its important functions with great zeal and activity, and attracted a greater number of members than could well have been expected in that rude period of society."

And in Dr Thomas Reid's "Statistical Account," which was written about 1794, we find it stated that in 1452 there were already 100 members of the University, most not young, including

canons, rectors, vicars, and presbyters, abbots, priors, and monks. Some years after, however, "many of the students were young men, to whom tuition, as well as teaching, was necessary, and therefore, provision was made that they should live and eat in one house which was called the *Pædagogium* or College of Arts." (The fact that only one College arose within the University is given by Hamilton, in a note to Reid's work, as one of the circumstances that "enabled the regents of that college more easily to usurp from the graduates at large the rights of academical teaching and legislation—to sink the public University in the private *Pædagogium*.")

I must refer those whose curiosity as to the vicissitudes of the University during the first 350 years of its existence is still unsatisfied, to Dr Thomas Reid's excellent "Account" above referred to, which is published in his collected works. There we read how the Reformation, established by law in 1560, brought the University almost to annihilation, how in spite of Queen Mary's new Charter granted in that year, the University continued to be plundered: we read of the "Nova Erectio" of King James in 1577 which set the University on its legs again, and of the endowments given by royal and other benefactors. We read how at the Restoration the endowments given by Cromwell lapsed, bringing the University again into a period of low water, which lasted till the Revolution, after which comes a long period of increasing prosperity. In 1702, there were 402 students of Theology, Greek and Philosophy. The University received gifts from the sovereigns from Anne to George II., and from other donors.

In the "Conclusion" of his "Account" Dr Reid is able to congratulate his University on its prosperity. He finds its local situation favourable, the state of its revenue sufficient, and its institutions and government advantageous. The students, he tells us, average considerably over 600 in number, submit to a moderate discipline, and are taught better (he hints) than in certain unnamed "colleges where no lectures are given."

The Commission of 1826.

In the Report of the Commissioners who were appointed in 1826 to visit the Scottish Universities, and who completed their

work in 1830, we find much information as to the past and present of all the Scottish Universities. It may be of interest to quote some extracts from the statistics given in the appendices to that report, relating to the number of students at the various Universities.

Appendix on Edinburgh, p. 161.

"The number of students attending the different classes, with the exception of Divinity students, was as under :—

Year	Total
1791	757
1801	857
1811	1475
1821	1941
1825	2013

"The increase in the number of Divinity students has also been very great. In 1801, the first year of which the number is enrolled, it was 136.

Year	Regular	Irregular	Total
1811	118	51	169
1821	182	101	283
1825	131	92	223"

Appendix on Glasgow, p. 263.

Here we find a table compiled from the Annual Catalogues of the *Togati*, or Gown Classes, from 1798-9 to 1828-9, from which I extract the following totals :—

Year	Total of <i>Togati</i>
1800-1	255
1810-11	639
1820-21	661
1824-25	702
1828-29	580

The following remark occurs :—"It appears that the whole number during session 1826-7 was 1222, and for the Session 1827-8, 1257. These numbers include students of Divinity, Law, Medicine and Arts."

Appendix on the University and King's College of Aberdeen, p. 327.

Numbers in 1812, exclusive of Divinity students, 156

Do. 1826-7 do do., 235

Divinity students in 1817, 106

Do. 1826-7, 150

“The average age (of admission) may be taken about 14.”

Appendix on Marischal College, Aberdeen, p. 357.

“The number of students attending the Marischal College during session 1826-7, exclusive of Divinity and Medical students who belong to both Colleges was 225. Medical students, 68; Divinity students the same as at King’s College. There has been a great addition to the number of students within the last 20 years.

“The average age at which students commence their course at Marischal College is 12. There are a good many younger.”

Appendix on St. Andrews, p. 408.

United College—Numbers *commencing their course* in 1777, - 25

Do. do. do. 1826, - 85

Total students in United College and in St. Mary’s—

Year	United College	St. Mary’s
1820-21	190	—
1821-22	204	—
1822-23	216	—
1823-24	221	—
1824-25	266	—
1825-26	223	89

With regard to Edinburgh and Glasgow there is no statement as to the average age of the students in general, or of the average age of first admission, but we find (page 244) that in the Humanity class at Glasgow about $\frac{1}{10}$ or $\frac{1}{12}$ of the students are supposed to be below 12 years of age (some only 10), and a limited number are from 30 to 40. The average age is supposed to be 14 or 15. Again (p. 246) the average age in the Logic class is 15 to 16.

Degree Examinations about 1830.

From a perusal of this interesting and elaborate report, one rises with the impression that the Universities of Scotland were in

a flourishing state as regards the number of students, but that the general level of academic study was not a high one. As to degrees in Arts the Commissioners' report, p. 39, "In all the Universities of Scotland, till very recently, and in some of them even at the present time, the degree of Master of Arts, that of Bachelor having fallen into disuse, has been conferred almost as a matter of form, not being withheld from any student willing to pay the fees, which have been regarded as one branch of the revenues of the College. In general there was no examination, or a very slight one, not calculated to ascertain the qualifications of the candidate." They then go on to make proposals for reform in this matter, and it is interesting to note that they seem to have proposed some form of individual examination of each candidate, as will be seen from the following quotation, p. 41.

"That the Examinations for Degrees should be open to all who may choose to attend."

"That the Examinations take place annually at such times as the Senatus Academicus may appoint, and the hours of examination to be from ten till four."

"That not more than six candidates should be examined in one day."

One notable recommendation of this commission has never been carried out, viz., the erection of a new University at Dumfries.

The Commission of 1858.

The next Royal Commission sat from 1858 till 1863. Its chief work seems to have been the re-organization of the government of the Universities. It established the University Courts as the ruling authorities in the four Universities. The Universities Act of 1858, which set up the Commission, had already put an end to the distinction in Glasgow between the University and the College, as two distinct Corporations, and it had instructed the Commissioners to carry out the union of the two independent Universities of Aberdeen. It also considered the question of founding a single National University for Scotland, to comprehend the present Universities as Colleges within it, but decided against the proposal.

This Commission provided in one of its ordinances for the

recognition of extramural teaching in the Faculty of Medicine in the Universities of Glasgow and Aberdeen, so that thereafter Glasgow was able to follow the example of Edinburgh in this matter.

The Commission of 1876.

The next Scottish Universities Commission sat from 1876 to 1878 and reported on various matters, including the government and finance of the University, the course of study and regulations for graduation, and other details of university administration. In particular it took much evidence on the subject of extramural teaching, and stated fully the reasons which weighed with the Commissioners when they recommended that no extramural teaching should be permitted in the Faculty of Arts. I shall have occasion to refer to this later.

The Commission of 1889.

The Commission of 1889 strengthened the University Courts, and gave power to each (subject to certain checks) to issue new ordinances for the regulation of the affairs of its University.

This Commission also initiated certain other changes of a far-reaching character. Perhaps the most important of these was the admission of women to become students and graduates under practically the same conditions as men. The women students in Glasgow now form nearly 25 per cent. of the total number.

Next might be mentioned the reorganization of the financial arrangements of the universities, and in particular, the formation of a *fee fund* from which the various professors draw fixed salaries. The previous arrangement was that each professor drew the fees of the students in his department, paying out of the proceeds the salaries of any assistants he might employ. The new arrangement possesses this great advantage, that the admission of supplementary teachers in any department can now be effected without directly touching the pocket of the professor, so that difficulties that might otherwise arise when the university desires to increase its teaching staff have now no existence.

Amongst other changes of importance may be mentioned those made in the status of lecturers and assistants; the institution of a Faculty of Science, which, like those of Medicine and Theology,

can recognize extramural teachers ; and the considerable alteration in the rules for graduation, particularly in Arts. Whereas formerly all the candidates for the degree of M.A. were bound to take the same 7 subjects, the ordinances of the Commissioners permitted a wide choice. These regulations have again been considerably altered by the new ordinance, which reduces the number of subjects that must be taken to 6 or 5 instead of 7, and so permits of greater concentration on the part of the student.

This last ordinance has also altered to some extent the duration of the session, and the rules regarding the nature and number of the meetings of a class which is to count for graduation.

Two Projects of Reform.

I have occupied more of your time than I had intended in the preceding references to the history of our universities ; I now propose to discuss two projects of reform, which I have long considered to be of crucial importance to the welfare of our universities.

The first of these projects is that of admitting duly qualified graduates to the privilege of teaching in the University. This project, I am glad to say has already been taken up seriously by the General Council of the University of Glasgow. A committee of the Council has considered the following remit :—

“To consider the advisability of instituting in the University an order of lecturers having a status similiar to that of the Privat-Docenten in the German Universities, *i.e.* having the privilege of giving courses of instruction counting for graduation, and having the right to use lecture-rooms in the University Buildings.”

The committee while pointing out certain difficulties, has reported favourably on the principle of the project, on the following grounds :—

“(1) For the Privat-Docent himself the time spent in this capacity is invaluable as an apprenticeship in handling University classes. (2) It gives further opportunity for increasing his knowledge in his particular subject or department. (3) The arrangement provides useful competition of several lecturers in the same branch, and a free choice of instructors to the students. (4) This competition tends to keep the instruction fresh, and to prevent its getting into ruts. (5) The personal relation of the

student to his teacher is allowed largely to rest upon the fact that he is not assigned to this or that instructor by any outward compulsion, but that he decides upon this one or that one of his own unrestricted choice. (6) To the existence of the Privat-Docenten must also be attributed a large share in the striking literary output of the German Universities, and (7) to the creation of that 'learned class' to the non-existence of which among ourselves successive Royal University Commissions have drawn attention. To this must be added the important consideration that they are no burden on State grants, or on the endowments of the University, but are supported entirely by the fees of such students as they can attract to their courses."

The committee has also given statistics shewing the importance of the Privat-Docenten in the German Universities. It has the project at present under further consideration.¹

This project, if carried out, could not fail to have a profound effect on our University. It has often been pointed out that our universities, as compared with those of the Continent and America, are very seriously undermanned. This continues to be the case in spite of the fact that the staff at Glasgow has been considerably increased of recent years.

Men versus Buildings.

Great sums of money have come to the University from the public, from government, and from private persons. An utterly disproportionate amount of this has been spent on stone and lime, with the result that great solid buildings have been put up as if to last for centuries, which in a generation or two will be out of date, while not only the first cost, but the continual upkeep of these buildings causes the starvation of the University in its vital parts. The buildings, indeed, may be looked on as to some extent pathological symptoms. The nutriment supplied is not going where it ought.

In an American university you will find 50 teachers doing what a score must do in Glasgow. Now a university is not a building.

¹ For full information as to the German system of Privat-Docenten, reference may be made to the authorized translation of Paulsen's book on the German Universities (Longmans & Co., 1906,) and to F. Eulenburg's "*Der Akademische Nachwuchs*" (Teubner, 1908.)

Our own University began its career without any elaborate buildings ; and to come to more recent times, the University of Göttingen, founded by our George II., in 1734-7, attained a world-wide fame before it had even lecture-rooms, the professors receiving the students in their own houses. Good buildings are a considerable advantage, but the real university consists in its active resident members, its teachers and students. You may pile up stones, and install steam and electric power and all sorts of scientific apparatus till you cannot bear the burden of upkeep, and yet not have a real university. On the other hand, if you succeed in bringing together able and worthy teachers and students and investigators, and give them freedom to study and learn and teach, you will have a university which will soon justify its existence, and bring forth the fruits of free enquiry and research.

Misdirected Energy.

But if you begin with a university which in virtue of all sorts of regulations has the virtual monopoly of the higher branches of study, and if you lay down minute regulations as to courses of study and examinations, and set a small staff to put the students through their curricula, and if you say to the "extra-academic" teachers who may knock at the gates, "we have not room for you, for you would take some of our fees, and we cannot afford it," then, however able may be your staff, and however enthusiastically they may begin their task, you cannot have an efficient university. It is not merely that with half the proper staff you will only get half the true educational work done. Worse than that, the energies of the staff will be to a great extent used up in mere mechanical details. "*Things* will be in the saddle," and intellectual life will be choked.

Some effects of University Monopoly.

It is to be remembered, too, that this state of things within the University will react on the teachers without it. There is even now, in spite of the slight pecuniary encouragement, quite a considerable number of teachers outside the University who are men that have taken high academic honours and are devoting themselves to the teaching of what might be called university

subjects. These are forced by the monopoly of the University to devote most of their energy to "cramming" students for the University Examinations. Here, again, a good deal of skill and energy is more or less misdirected and wasted, that might, with a more liberal policy in the University be utilised to the benefit of all concerned.

Freedom of Teaching.

In the early days of the University it was different. We read in the preface to "The University of Glasgow, Old and New," 1891, page x.

"Theoretically the function of teaching and lecturing in each faculty belonged to all who had attained the degree of Master or Doctor in the Faculty, whether at Glasgow or at any other regularly constituted University. It is probable, indeed, that the whole system of graduation was introduced with the object of distinguishing such of the scholars as were competent to teach others, from those who were not; as indeed may be gathered from the forms still in use in admitting to the degrees of Master of Arts and Doctor of Medicine. And at first it formed part of the oath taken by every Master of Arts on graduating, that he would continue to read—*i.e.* to lecture—in the Faculty of Arts for the space of two years; and if he failed to do so, he subjected himself to a fine, unless he had previously asked and obtained a dispensation from the Faculty. By and by it was found necessary to place some limitation on this general right of teaching common to all graduates; and thus the distinction was introduced between the *Magistri Regentes* or Regents, and the *Magistri non Regentes*, the former alone being engaged in the work of tuition, though both classes of Masters were included in the Faculty, and took part in the administration of its affairs."

In the German and Austrian Universities, the *Privat-Docent* is the successor of the teaching graduates of mediaeval times, and it is somewhat strange that in the University of Adam Smith a closer monopoly of teaching should exist than anywhere else in Europe.

A Contrast.

Our University has shown it can be liberal when its own monopoly is not in question :—

"James Watt," as we are informed by Lord Kelvin in his oration on the occasion of the ninth jubilee of the University, "was not allowed by the city and trade rules to work as an instrument maker in the City of Glasgow, because he was neither the son of a burgher, nor married to the daughter of a burgher, nor a passed apprentice to any trade. He was forbidden to set up even a humble workshop with himself as solitary tenant within the limits of the burgh. The University is now happily within the burgh of Glasgow. Happily it was not in the burgh in 1757, and it was able to give James Watt protection from tyrannical usages outside its bounds. By midsummer of that year he received permission to occupy an apartment and open a shop within the precincts of the College."

This episode contrasts somewhat strangely with the present attitude of the University, which recognizes, it is true, the "extra academical" teacher, but jealously excludes him from the use of the University class-rooms, many of which are "eating their heads off" during a great part of the day.

Can this jealousy of the outsider be a subtle effect of the name University, which proclaims it to be of the nature of the incorporation of a mediaeval burgh, which included in itself the different trades and crafts, just as the University includes its Faculties?

Even if the regular staff of the University were sufficient in number to perform its work efficiently, there would still be strong reasons for the existence of a class of teachers having the status of the Privat-Dozenten of the German Universities.

Some of these reasons have been formulated in the report by the committee of the General Council, above quoted, some I shall refer to later when considering objections that have been raised.

Second Project of Reform.

The second special project of reform which I have to refer to, is one to which I attach very great importance. It refers more exclusively to the internal working of the University, and I am not aware that any existing ordinance could prevent its being put into effect, if the Court and the Senate decided upon that step.

"At present the work of the student preparing for a degree in Arts or Science is dominated by written examinations of candidates en masse. That is, the same paper of questions is set to

all candidates. This domination is modified somewhat by compulsory attendance at certain classes, which is understood to prevent cram¹ to a certain extent.

"I wish to adduce reasons showing that compulsory class attendance cannot, and in practice certainly does not, sufficiently prevent cram; that examinations of the present type, in which the questions must be *either* commonplace, *i.e.*, capable of being crammed for, *or* unfair, necessarily cause most students to spend most of their time at College in cramming for examinations; that in compulsory classes the teaching either conforms itself to the needs of the student, or acts on him like water on a duck's back; and that the true remedy is to alter our system of examination by adopting these two principles:—(1) Individual examination of each candidate. (2) Insistence on the performance of a piece of original work by each candidate in one subject at least, not in the examination room, but at leisure, and with the usual aids to work. The application of these two principles would secure a far higher type of university work. The former would secure to the student the recognition of all the good work he might do within the limits of his subject, and relieve him from the temptation continually to calculate the examination value of each section; and it would extinguish cram. The latter would educate the student's power of doing real work, as opposed to the power of making shots at questions. But note besides these direct results:—(1) The proposed new type of examination would remove the difficulty in arranging degree examinations for several, or even an unlimited number, of different courses of study. (2) It would make it possible to abolish compulsory attendance on particular classes, and to introduce freedom of teaching and freedom of learning. The examination of the type I have indicated should come at the end of the curriculum. In the German Universities it is not found necessary to have any 'previous' or intermediate examination during the course; but in our Universities the standard of attainment of the students at entrance is lower, and an examination of the presently existing type at the end of the first year might be desirable."

¹ By *cram* or *cramming* I mean study with the immediate object of becoming able to answer a set of questions of a type known or guessed at by the student. It is not necessarily bad—it is a most valuable discipline *when kept in its proper place*.

These words I addressed 18 years ago to the Scottish Universities Commission then sitting, and further experience has only confirmed me in the opinions then expressed. When I appeared before the Commissioners I was asked how the time could be found to examine individually all the students who are candidates for degrees. The idea seemed to strike them as absurd. And yet the type of examination which I advocated has for generations held the field in the German Universities, and as a matter of fact the degree examinations there do not consume nearly so much of the time of the examiners as do those of our British Universities. I have been told by a German professor who has acted on many occasions as an examiner, that it takes but an hour or two to examine a candidate, and that it is possible in that time to question him "right up to the limits of his knowledge." And if we reckon up the number of written examinations which must be passed by a Glasgow candidate for the M.A. degree, the time required for drawing up, for correcting and for printing the questions, and the time required for reading and marking the candidates' answers, we shall find that our "wholesale" examinations are not really economical.

Let me quote in support of my views from the address delivered by Professor Chrystal in 1885, as President of Section A of the British Association for that year, and printed in the 'Report.'

Professor Chrystal on Examinations.

Page 892. "The history of this matter of problems, as they are called, illustrates in a singularly instructive way the weak point of our English system of education. They originated, I fancy, in the Cambridge Mathematical Tripos Examination, as a reaction against the abuses of cramming bookwork, and they have spread into almost every branch of science teaching—witness test-tubing in chemistry. At first they may have been a good thing; at all events the tradition at Cambridge was strong in my day, that he that could work the most problems in three, or two and a half hours was the ablest man, and, be he ever so ignorant of his subject in its width and breadth, could afford to despise those less gifted with this particular kind of superficial sharpness. But, in the end, it came all to the same: we were prepared for problem-working in exactly the same way as for bookwork. We were

directed to work through old problem papers, and study the style and peculiarities of the day and of the examiner. The day and the examiner had, in truth, much to do with it, and fashion reigned in problems as in everything else. The only difference I could ever see between problems and bookwork was the greater predominance of the inspiring element of luck in the former. This advantage was more than compensated for by the peculiarly disjointed and, from a truly scientific point of view, worthless nature of the training which was employed to cultivate this species of mental athletics. The result, as far as problems worked in examinations go, is, after all, very miserable, as the reiterated complaints of examiners show. Against the occasional working and propounding of problems as an aid to the comprehension of a subject, and to the starting of a new idea, no one objects, and it has always been noted as a praiseworthy feature of English methods, but the abuse to which it has run is most pernicious. All men practically engaged in teaching who have learned enough, in spite of the defects of their own early training, to enable them to take a broad view of the matter, are agreed as to the canker which turns everything that is good in our educational practice to evil. *It is the absurd prominence of written competitive examinations that works all this mischief.*¹ The end of all education now-a-days is to fit the pupil to be examined ; the end of every examination not to be an educational instrument, but to be an *examination* which a creditable number of men, however badly taught, shall pass. We reap, but we omit to sow. ”

Page 893. “When our system sets such mean ends before the teacher, and encourages such unworthy conceptions of education, is it to be wondered at that the cry arises that pupils degenerate beneath even the contemptible standards of our examinations? These can hardly be made low enough to suit the popular taste. It is no merit of the system we pursue, but due simply to the better among our teachers, men many of them who work for little reward and less praise, that we have not come to a worse pass already. Some even of the much-abused crammers have conceptions of a teacher's duty far higher than the system-mongers of the day, whom it is their special business to outwit ; and it is but

¹ (The italics are mine. R. F. M.)

fair to allow to such of these also as deserve it part of the credit of stemming the torrent of degeneration. . . . ”

Page 894. “All the same, the task of reformation is not an easy one. Examinations have a strong hold upon us, for various reasons, some good, some bad, but all powerful. In the first place, they came in as an outlet from the system of patronage, which with many obvious advantages, some of which are now sorely missed, had become unsuited to our social conditions. There is a certain advantage in examinations from the organiser's point of view, which anyone who, like myself, has to deal with large quantities of pretty raw material will readily understand. . . . It is only when the answers are dissected in the examiner's study that the rottenness is revealed underlying the fair outward skin. But then the examiner must go by his standards; he must consider what is done elsewhere, and what is to be reasonably expected. Accordingly he takes his report and quickly writes so many per cent. passed. Then the chorus of reporting examiners lift up their voices in wonderful concordance; and all, perhaps even the examiners, are comforted. There is something attractive about the whole thing that I can only compare to the pleasure with which one listens to the hum of a busy factory or to the roaring of the forge and ringing of the anvil. But what avails the hum of the factory if the product be shoddy, and what the roar of the forge and the ring of the anvil if the metal we work be base?”

Some of Professor Chrystal's words refer more particularly to the examinations of the “Science and Art Department” as it then existed, when papers were set for the whole country, but the most of them are quite applicable to University Examinations.

Does Compulsory Attendance Prevent “Cram”?

It is claimed, by defenders of the present system, that the professorial discipline prevents cramming for examinations, and that the professor's lectures are above the standard of the degree examinations. This is true only to a very limited extent. So long as examinations have their present estimated importance, they will, to a great extent, dominate study. Set a “wholesale” written examination, and you make the students cram—a very useful exercise in some stages of education, but wasteful and hurtful when it monopolizes the energies of the student.

Examination by "Thesis."

I shall be asked—"But do you really expect that the ordinary student will write an original thesis? Originality is rare." To this I reply that originality (in one sense) does not exist at all, and never will, but what is required in Germany, and ought to be required here is simply a piece of real work. It may be an experimental investigation in chemistry, an essay in classical archæology, or a historical monograph, or some slighter effort. Its essential requisite is that it shall evince mastery of some department of study, and contain something that is new. The latter proviso is, of course, very vague, and may have a different interpretation at different universities. But the system works well in Germany, and has the crowning merit of encouraging the student to do the best work of which he is capable.

Concentration in Study.

Another objection to the German type of examination is that it induces specialism in study to a hurtful extent. That might be so were the student shut up in solitary confinement, and denied the privilege of reading outside his chosen line of study. But a student among students will not usually err by excess of concentration. Besides, to study one thing thoroughly is the real higher education, for this implies breadth as well as depth of culture, while mere breadth does not imply depth. He who has mastered one thing thoroughly, has learned the art of mastering others. The poet well said that the study of one object, be it but a "flow'r in a crannied wall," will take the student far, if the study be thorough.

A Difficulty.

One objection does carry real weight. It often happens in the German Universities that a student idles his time during the first year or two, and leaves his work to be done "mit Müh und Noth" near the end of his course, and sometimes he becomes a confirmed "waster." This, of course, occurs to a less degree under all systems of examinations. It could be diminished by instituting an intermediate examination at an earlier period of the course. The absence of discipline, such as compulsory attendance at

classes, is admitted by the Germans to cause a large waste of student material : but they think the loss is compensated for by the greater value of the work done. As Helmholtz has said, referring to the English system : "There is no doubt that, by such a system, many a one would be saved who is ruined by freedom. But the State and the Nation can best be served by those who have shewn that they know how to work and to struggle from their own force and insight, and from their own interest in science." It is to be remembered, too, that much of the wastage amongst the German students must be put down to reaction from the stern discipline of the "gymnasium." The average Scotch schoolboy going up to the University has a better balanced mind, and is less likely to prove unfit for freedom than is his German cousin.

Importance to us of the Example of Germany.

The example of the German Universities in these matters is one that we cannot afford to overlook. In many respects they resemble our own. They are National Universities, restricting their benefits to no class. Their teaching, like ours, is mainly carried on by professors and lecturers, and their students, like ours, reside in the University town, but without restriction as to where they shall lodge or eat. And we are told by Professor Hume Brown in his article on Universities in Chambers' Encyclopedia that "Germany, which in respect of its universities took the last place in the middle ages, has in the modern period led the way from the first—the conclusive attestation of its pre-eminence being that its schools alone can now be called cosmopolitan."

Cambridge and Oxford.

We can learn something too, from Oxford and Cambridge, though their character and work differs much from that of our Universities. Most of their undergraduates come from the so-called Public Schools, and so far as they are concerned, the University system is simply an extension of the Public School system. The undergraduate has rooms in College or in a licensed lodging house assigned to him. The College Tutor takes the place of the House Master at School, and takes care that his pupil does not stay out too late o' nights or omit due attendance at

morning chapel and dinner in the hall, and that he does not neglect his studies. The Colleges are primarily institutions for the board and tuition of undergraduates, while the University as such sets the degree examinations and grants degrees. Athletics, on the river and elsewhere, usually fill up the afternoon, and social intercourse is not neglected in the evening. The work done by a "Tripos man" or honours' student at Cambridge is of a more advanced character than School work, but is of the same type, dominated by the written examination. Matthew Arnold, comparing the English with the German Universities says: "Our University system is a routine, but it is our want of science, not our want of liberty, which makes it a routine." But I am convinced that want of liberty is the chief reason for want of science. And the same critic admitted that if the French Universities had no liberty, and the English Universities no science, the German Universities had both.

Probably matters have improved somewhat since Matthew Arnold wrote, but the domination of the "wholesale" written examination still continues.

Efficiency of Cambridge Tuition.

But the "coaching" for these examinations which is done by private "coaches" and College lecturers is carried out with praiseworthy thoroughness.

"There is a three years' course of mathematical drill at Cambridge not to be matched in any other country in the world," says Dr Thomas Muir, in his address to the Edinburgh Mathematical Society in 1884. "This superiority of Cambridge is quite independent of the question whether the system pursued there be in its details good or bad. There are many thoughtful mathematicians and other men of science . . . who deprecate . . . the utilitarian spirit which sacrifices everything to what is known to 'pay' in examinations; and they deplore that almost unique and absolute power it possesses of quenching originality."

The Scotch Student who goes to Cambridge.

Another passage (p. 11) of Dr Muir's address is of interest: "We recognize two of the functions of a university—*instruction*

and *research*; we ignore, as far as mathematics is concerned, a third and equally important function,—*instruction in research*. A Scotch University student who has a special taste for mathematics, and has come to the University to develop that taste, has usually something like the following career:—Of the two or three mathematical classes taught in the University, he very probably enters the highest.¹ There he obtains a knowledge of synthetic and analytical conics, the elements of the different calculus, and, it may be, of the integral calculus as well. He knows there is no hope for him if he does not take his Master of Arts degree, and he gives his attention to classics and mental philosophy with this end in view, continuing by himself his reading in mathematics as far as it may be possible to do so. In time he graduates; this entitles him to compete for a scholarship: he competes and is successful, leaves for Cambridge, and his University knows him no more. Probably in the newspapers we observe that Mr Donald Scott of a certain northern University has gained an open scholarship at Johnshouse, and the competition having been between him and a number of young men fresh from the English public schools, we are gratified accordingly with his startling success. Gentlemen, I put it to you, if this is a thing for us as Scotsmen to be altogether proud of . . . the Scotsman who glories in the part his Universities play in the matter glories in his own shame. Is it really past hoping for that all this may yet be changed?" Dr Muir then goes on to suggest that Donald Scott, instead of going up to Cambridge, should remain in his own University, there to grow in knowledge under his favourite professor's guidance, doing 'prentice work that will be valuable to himself, and, at worst, harmless to others. He faces the question "What careers are there open for such men after they have completed their post-graduate course" and finds the outlook hopeful: but one fancies a good deal would depend on the attitude of the "favourite professor" who might or might not be relied upon to welcome the younger man. The chief reason why Dr Muir's suggestion has been so little acted on, and why our "fellowships" and post-graduate "scholarships" have been so ineffectual in promoting higher study, would be removed, if Glasgow had its privat-docents.

¹ There is now an "Advanced Honours" class which begins where the highest class in Dr Muir's time left off.

The Commission of 1876 and Extramural Teaching.

It is time now that I should consider the reasons which weighed with the Commissioners of 1878 and 1889 when they decided not to permit extramuralism in the Arts faculty. Let me quote some of the paragraphs of the report of the former Commissioners which seem to give the gist of their views.

The Report of 1878. Page 80. "It is a feature of the Scotch University system, and in our opinion, a highly valuable feature, that the Universities teach as well as examine for their degrees; and we do not think that, consistently with the preservation of their character in that respect, the conditions under which extramural teaching is now admitted could safely be relaxed. These conditions we believe to be as liberal as those of any University which is not merely an examining body."

Page 81. "Confining our observations for the present to the Faculty of Arts, it is said that the objects proposed in the instruction given in Faculties of Arts and Medicine are not the same. The primary object of the teaching in the former Faculty is culture, in the latter to impart information. Hence, while it may not be very material for the University in the one case to inquire where a candidate has acquired his information, provided he gives proof that he possesses it, the mere test of an examination in the other is not sufficient to show that the student has cultivated his faculties in that way which it is the aim of his university training to ensure."

Page 82. "But, were there to be rival teaching for the degree, were there to be a competition for students between the professor inside and lecturers outside the University walls, and if, as might be expected, some of the outside lecturers were to seek a reputation of being successful in preparing their pupils speedily for the examinations, and to shape their teaching to that end, the professor might be tempted in self-defence, and in order to prevent his students from deserting him, to follow a similar course. The evil effects of what is expressively termed the 'cramming' system might be apprehended, and the examinations would come to have that narrowing influence on the university instruction which hitherto they have not had in Scotland, and the existence of which in some quarters elsewhere has been deplored."

Professor Blackburn, in replying to the question, "Is not

competition a good thing?" said, "No there is a great fault in competition. What would it be competition for? Simply for coaching men to pass a certain examination. The result of that would be that the professor would either be outbid, or he would take to cram for the examination; and it is utter ruination to a man to teach for the purpose of making his students pass an examination."

Page 83. "In the views stated by these witnesses we fully concur. We think the statement is justified, that at present the teaching of the professors is considerably beyond the requirements for the degree; and any step that would tend to lower its character, ought not, in our opinion, to be taken without its appearing that the advantages it holds out are such as to compensate for the evil. The most weighty argument on the other side of the question is that founded on the case of an inefficient professor, to whose teaching it may be desirable to have an alternative course open to the students outside the University. But cases of inefficiency in professors are not frequent."

I may remark in passing that the statement that "the conditions under which extramural teaching is now admitted are as liberal as those of any University which is not merely an examining body," though perhaps literally correct, is somewhat misleading, since privat-docenten are welcomed in the Philosophical Faculties of the German Universities (which correspond to our Arts Faculties) and at Oxford and Cambridge there is, I believe, no compulsory attendance for graduation purposes in the case of any professor's or lecturer's class.

Some of the Evidence on Extramuralism, &c.

The evidence of one or two witnesses *against* extramural teaching in all faculties are quoted in the Report, while that of the large number who testified in its favour is merely alluded to. I have read most of the evidence on this point printed by the Commission and I have been struck with the amount of weighty testimony in favour of relaxation of professorial monopoly, either in favour of "extramural" teachers, or of graduates within the walls.

Professor Tait, when asked if he had considered the expediency of recognizing extramural teaching, replied, "I have felt con-

vinced it is only a question of time. Extramural teaching must be recognized some time or other." "I think the advantages of the system are immensely great, but of course existing interests would have to be provided for before the teaching was thrown open."

Professor John Young suggests "the propriety of establishing within our own walls, and under our own supervision, a system of additional instruction by *privat-docenten*."

Professor Pirie, D.D., of Aberdeen, "could not see the slightest objections to extramural teaching in Arts."

Professor Blackie said "University graduates of a high standard should be allowed to teach within the walls."

Professor Calderwood, when asked if he thought the system of extramural teaching might be introduced into the Faculty of Arts, said, "I think the time has come when it would be very desirable to consider the propriety of introducing such teaching, under proper regulations compatible with the efficiency of teaching in the University."

Professor Masson said, "I think it would be desirable that there should be some opening of our present teaching—more liberty, and a greater variety of teachers, on two grounds. First, to give protection against the chance of incompetent professors. . . . More important still, it seems important that there should be a multiplication of teaching posts in Scotland for the purpose of creating a learned class."

Professor Charteris, D.D., "would recognize extra-professorial teaching, whether extramural or intramural in every faculty and in every class."

Professor Struthers, Aberdeen, "does not agree with the arguments of the Aberdeen Senatus against extramural teaching.

. . . Would at once open the teaching in all the faculties."

I might quote many other pronouncements equally emphatic in favour of opening university teaching to graduates.

Principal Caird seems to have occupied a middle position. He saw a difficulty in recognizing teachers entirely outside the university, but suggested that the end contemplated "might be sufficiently overtaken by having graduates of our own teaching during the summer months."

Of those who gave evidence decidedly adverse to the extension of extramural teaching to the Arts Faculty, I might mention

Professor Edward Caird and Professor Ramsay. But the former added: "I desire to say that some of the classes now are increasing beyond the possibility of management by a single professor, and that if extramural teaching is not to be introduced, there should be a larger number of intramural teachers—that is to say, for instance, there should be two or three professors of Latin."

And Professor Ramsay "does not think that the success of the privat-docenten system can bear comparison with that of extra mural teaching, because the former is strictly intramural."

It will be seen then, that those who opposed the admission of pure extra-mural teaching into the Arts Faculty would not necessarily oppose the project of licensing graduates to teach within the walls with privileges similar to those of the German Privat-Dozenten.

Are the Commissioners' Reasons Sound?

Let us consider now for a moment the special grounds on which the Commissioners decided against freedom of teaching.

Apart from the financial difficulty (which was considered of secondary importance by the Commissioners, and has now been practically solved by the institution of a fee fund for the professors) they hold that in the Arts Faculty, the extramural teachers would be tempted simply to "cram" for the examinations, and that the professors would be tempted to follow suit. (One tries to imagine Lord Kelvin feeling this temptation.) They quote with approval Professor Blackburn's dictum "it is utter ruination to a man to teach for the purpose of making his students pass an examination." (At that particular date Mr Routh at Cambridge was suffering this "utter ruination:" but I wonder how many students who attended Professor Blackburn's classes and those of Mr Routh would have observed this.)

Let me reiterate that if you want to stop cramming, you must alter the type of your examination. No amount of compulsory attendance on a professorial class will do it.

The Commissioners seem to have had in their minds, as sole alternative to the present system of the Scottish Universities, some system like that of the University of London as it then existed, where students prepared for the examinations of the examining

body by private study, or study assisted by tutors, without necessarily residing at any University, not perhaps mixing in any society of students and teachers devoted to the pursuit of knowledge. They shut their eyes to the brilliantly successful example of the German Universities, and they fail to realize the true reason of the prevalence of the "cramming" which they deplore.

Again the Commissioners say: "the most weighty argument on the other side of the question is that founded on the case of an inefficient professor." This is, I think, quite erroneous. Three teachers are better than one, even if that one be first-rate. Besides, the greatest genius is often not a good teacher. Gauss, who for 50 years was the ornament of the University of Göttingen and the greatest mathematician of his time, lectured very little, but he did not prevent others from lecturing, and there were other professors and docents in his department, and the mathematical school of Göttingen flourished splendidly, and does so yet, though Gauss has been dead 50 years.

And see how the single teacher is hampered under our Scotch system. He must either keep his teaching within reach of the weaklings of the class, and disappoint the good students, or consider the latter and neglect the former. If there were freedom of teaching, it would be possible for all classes of students to find teaching suited to their needs; and for all the teachers to devote themselves to the kind of teaching for which they were best fitted. At anyrate there would be some chance of this ideal state of affairs being approximated to.

A Concrete Example.

A recent occurrence in the University of Glasgow may be mentioned without offence, which illustrates the hampering effect of our hide-bound system. One of the assistants in the mathematical department, who is now a professor in a Colonial University, in one of his classes dealing with geometry departed considerably from the traditional treatment of the subject, by elaborating and making more explicit its logical bases. The course was an excellent one, and by the mathematically-minded students of the class was found, I believe, helpful and stimulating. But the majority of the class could make nothing of it, and I believe this particular deviation from the rut has not been persevered in.

The Commission of 1889 and Open Teaching.

The later Commission (that of 1889) contented itself, so far as the question of open teaching in the faculty of Arts is concerned, with repeating the arguments of its predecessor, though it removed one great practical difficulty in the way by its institution of a fee fund. The Report of this Commission contains the remark that "under Ordinance No. 17 the Court may appoint Lecturers on any subject not already taught," and argues that in this way there will be all the competition within the University which is necessary or desirable. This is a somewhat optimistic view.

Conclusion.

To conclude: the Arts Faculty above all the others is that in which real liberal education should be imparted, and where some of the vital thinking of the nation might be transacted. It is not, like the other faculties, bound to regulate its examinations by the needs of any profession, and could, therefore, set an example in giving up a type of examination which dooms much of its activity to sterility. And by opening its doors to ambitious and able teaching graduates it would not merely save them from the alternatives of becoming "extramural crammers" or giving up their ambitions to study and teach, but it would give the present staff a better opportunity to do good work, and enable the professors to step down from the pedestals on which they are perched like glorified schoolmasters, to take their places as elder brothers in a band of brothers working for the advancement of human knowledge.

May we look forward to having one day, on the banks of the Kelvin, a University such as John Henry Newman imagined:—"It is the place to which a thousand schools make contributions; in which the intellect may safely range and speculate, sure to find its equal in some antagonist activity, and its judge in the tribunal of truth. It is a place where inquiry is pushed forward, and discoveries verified and perfected, and rashness rendered innocuous, and error exposed, by the collision of mind with mind, and knowledge with knowledge. It is the place where the professor becomes eloquent, and a missionary and preacher of science, displaying it in its most complete and most winning form, pouring it forth with the zeal of enthusiasm, and lighting up his own love of

it in the breasts of his hearers. It is the place where the catechist makes good his ground as he goes, treading in the truth day by day into the ready memory, and wedging and tightening it into the expanding reason. It is a place which attracts the affections of the young by its fame, wins the judgment of the middle-aged by its beauty, and rivets the memory of the old by its associations. It is a seat of wisdom, a light of the world, a minister of the faith, an alma mater of the rising generation. It is this and a great deal more."

Magnetic Bronzes. By ALEXANDER D. ROSS, M.A., B.Sc., F.R.S.E., Assistant to the Professor of Natural Philosophy in the University of Glasgow, and ROBERT C. GRAY, Thomson Experimental Scholar in the University of Glasgow.

[Read before the Mathematical and Physical Section,
23rd February, 1909.]

Materials Employed.

IN this paper are given the results of magnetic tests made on Heusler alloys of varying composition, on certain binary copper alloys, and on pure manganese and aluminium. The specimens, which were cast by Gray & Caldwell, Paisley, and Steven & Struthers, Glasgow, had the following compositions:—

TABLE I.—Analysis of the Specimens.

CASTING.	PERCENTAGE COMPOSITION.		
	Cu.	Mn.	Al.
B.	62·5	25·	12·5
D.	76·	16·	8·
E.	55·	30·	15·
F.	95·	—	5·
G.	90·	—	10·
H.	40·	—	60·
I.	30·	—	70·
J.	70·	30·	—
K.	—	—	100·
L.	—	100·	—

B is the ordinary Heusler alloy—the most magnetic of the manganese-aluminium bronzes. In D and E the same relative proportions (viz. those of the atomic weights) of manganese and aluminium have been maintained,¹ the amount of copper being varied.

Apparatus.

For the testing of the materials B, D and E the Gray-Ross magnetometer² was employed, the alloys being used as cast, in the form of cylinders 20 cms. long and about 1 cm. in diameter. The other materials were so feebly magnetic that they were cast as small cylinders 80 × 6 mms. and magnetised in a field of 4400 C.G.S. units between the poles of a large electromagnet, the permanent magnetism being thereafter measured by a delicate magnetometer.

Quenching and Liquid Air Tests on the Heusler Alloys.

Tests were made on alloys B, D and E in the cast and in the quenched condition, both at room temperature and at the temperature of liquid air. The general nature of the results is shown in Table II. In calculating the absolute values, the polar separation was assumed to be $\frac{5}{6}$ ths of the total length, and Du Bois's factors³ were employed to allow for the demagnetising effect of the cylindrical bars. It will be observed that

- (1) quenching the material reduces the hysteresis loss, but unfortunately for practical applications it greatly impairs the magnetic quality ;
- (2) the effect of immersion in liquid air depends to a large extent on the copper content of the alloys, specimens rich in copper being much more magnetic at -190° C. than at room temperature, and this variation of susceptibility with temperature is greatly increased by quenching.

¹ Heusler, Starck and Haupt have stated that this ratio gives the most magnetic alloys. *Ber. d. Deutsch. Phys. Ges.*, 1903, S. 220.

² *Proc. Roy. Soc. Edin.*, 1908-9, Vol. xxix., 3, p. 182.

³ *Ann. d. Phys. u. Chem.*, XLVI., 1892.

TABLE II.—Quenching and Liquid Air Tests on the Heusler Alloys.

Casting.	Condition.	Temperature.	I for H = 140	Residual Intensity.	Coercive Force.
B.	Initial	15° C.	317	75	1·3
		-190°	398	98	2·3
	Quenched	15°	273	32	1·0
		-190°	360	55	1·8
D.	Initial	15°	22	6·5	27
		-190°	25	8	28
	Quenched	15°	1·0	0	0
		-190°	3·5	1·0	13
E.	Initial	15°	9·0	0·9	12
		-190°	8·7	0·9	12
	Quenched	15°	1·5	0	0
		-190°	2·2	0	0

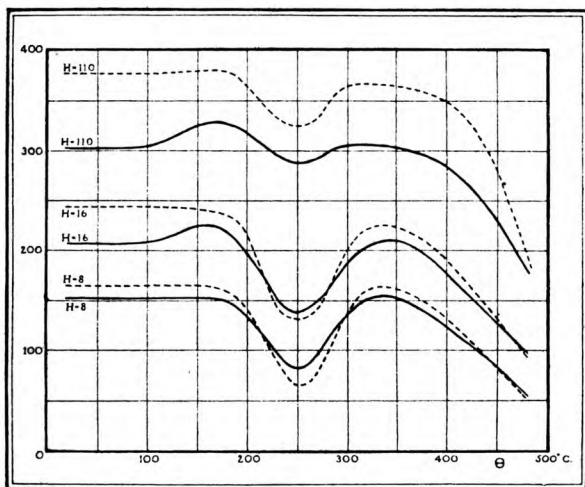
[Quenchings were carried out at 450° C.]

Baking of the Alloys.

The permanent effects of baking alloys B, D and E for varying periods at various temperatures up to 500° C. were investigated with a view to ascertaining what treatment would result in maximum permeability. In the case of D and E all thermal treatment resulted in a deterioration of the magnetic quality. For example, when alloy D is baked at 250° C. the results are

- (1) a reduction of the saturation intensity to about two-thirds of its original value ;
- (2) a slight initial increase in permeability for low fields ;
- (3) a final reduction of the permeability for any given field towards a definite limit ; and
- (4) a reversal of the liquid air effect when the new stable condition has been attained.

With alloy B the best condition is attained after baking for from 6 to 8 hours at 170°C . The saturation intensity is thereby augmented by over 10 per cent., and there is little or no increase in hysteresis. The permeability for low fields has however been reduced to a very slight extent. If the baking is continued for more than 8 hours the permeability then diminishes for all fields and the hysteresis loss rapidly increases.



The adjoining diagram shows the permanent effects produced by subjecting alloy B to various temperatures. Tests were made for a series of temperatures from 50° to 480°C ., the temperature of each baking exceeding the previous one by about 30° . In each case the alloy was placed in a furnace at the required temperature and kept there for three hours. The furnace was then shut off and the alloy allowed to cool. In the figure the abscissae represent the temperatures of baking and the ordinates the intensities of magnetisation. Results are given corresponding to magnetising fields of 8, 16 and 110 C.G.S. units. The continuous lines give

the intensities of magnetisation at room temperature, the dotted lines those at liquid air temperature. The curves show

- (1) the improvement in quality for high fields after baking at about 170°C .
 - (2) a pronounced deterioration in the magnetic properties after baking at about 250° . This deterioration is all the more remarkable as baking at about 330° produces little change in the susceptibility.
 - (3) a reversal of the liquid air effect for low fields after baking at from 220° to 280° .
- (2) and (3) point to important structural changes in the alloy at such temperatures.

Critical Temperatures.

The critical temperatures of the alloys B, D and E were found to differ greatly. In D (72% Cu) the critical temperature was only 280°C ., in B (62.5% Cu) 500° , and in E (55% Cu) 345° .

Binary Copper Alloys.

The values obtained for the residual magnetism in the tests on the aluminium bronzes, the manganese bronze, aluminium and manganese are given in Table III.

The aluminium bronzes F and I show an increased retentivity when cooled to liquid air temperature, and are also more magnetic after quenching. These two aluminium bronzes therefore, which alone of the four tested contained free copper,¹ give effects similar to those found in specimens of nearly pure copper.² Alloy G exhibits greater retentivity at liquid air temperature than at room temperature, but is less magnetic after quenching. This alloy is usually considered to consist chiefly of the compound Cu_3Al . Some investigators believe it to be a mixture of Cu_3Al and Cu_4Al , but the existence of Cu_4Al is not generally accepted. The 30% manganese bronze resembles the 5% and 70% aluminium bronzes in that its retentivity is greater at -190°C . than at 15°C ., and is

¹ Carpenter and Edwards, *Proc. Inst. Mech. Eng.*, 1907.

² Gray and Ross, *Proc. Roy. Phil. Soc. Glas.*, 1907-08.

greater in the quenched than in the cast material. This bronze consists of a solid solution of copper and manganese. As its magnetic behaviour resembles that of copper and is unlike that of manganese and such manganese compounds as manganese steel, it seems natural to ascribe the effects obtained to the free copper modified to a slight extent by the small effects which occur in the free manganese.

TABLE III.—Tests on Residual Magnetism.

CASTING.	MATERIAL.	INTENSITY OF MAGNETISATION.			
		Cast Material.		Quenched Material	
		Magnetised at		Magnetised at	
		15° C.	-190° C.	15° C.	-190° C.
F.	5% Al- bronze,	·010	·091	·029	·110
G.	10% „	·184	·228	·145	·175
H.	60% „	?	?	?	?
I.	70% „	?	?	·021	·027
J.	30% Mn- bronze	·057	·072	·096	·118
K.	Pure aluminium	?	?	?	?
L.	Pure manganese	4·76	4·68	3·74	3·70

? denotes that the value of I was less than 0·01.

Temperature of quenching 450°-550°C.

The Magnetism of the Heusler Alloy.

Hitherto the magnetisation of the Heusler alloys has been ascribed to the manganese alone, whose transformation temperature it has been conjectured is lowered by the solution in the other constituents. No evidence has been adduced to support this theory; and although the susceptibility of many manganous salts exceeds that of the corresponding ferrous and ferric salts,¹ this does not imply that manganese becomes more magnetic on com-

¹ Liebkecht and Wills, Phys. Rev., X, 4, 1900.

ination. The present experiments show that the magnetic behaviour of the Heusler alloys very closely resembles that of the 10% aluminium bronze, alloy D being suggestive also of the action of free copper. It therefore seems reasonable to suppose that the presence of Cu_3Al (or of Cu_3Al and Cu_4Al , if both exist) may play an important part in the magnetism of the manganese-aluminium bronzes, its effects being modified more or less by the presence of free copper or free manganese.

The investigations here described were carried out in the Physical Laboratory of the University of Glasgow, and the authors desire to express their indebtedness to Professor Gray for the facilities given for conducting the research.

[*Note added April 12th*—A paper has lately been published by Heusler and Richarz¹ in which, from the results obtained by several German experimenters, they deduce a series of magnetic compounds M_{3x}Al_x , where M represents a solid solution of copper and manganese, those two elements being known to dissolve in one another in all proportions. It will be observed that the compound Cu_3Al referred to in the present paper is a particular case of this general type.]

Recent Earthquakes and their Investigation. By ALEXANDER D. ROSS, M.A., B.Sc., F.R.S.E., Assistant to the Professor of Natural Philosophy in the University of Glasgow. A Communication from the Mathematical and Physical Section.

[Read before the Society, 10th February, 1909.]

WE turn our attention for a short while to-night to the science of seismology. The time is opportune. Within the last seven weeks there has occurred one of the most disastrous earthquakes on record—an earthquake which caused the death of thousands of people, which changed a season of mirth and gladness into a time of mourning and deep sorrow. In the brief space of some twenty seconds, thousands perished in the appalling catastrophe, cities were razed to the ground, and a country of peace and plenty was changed into the scene of plague, of fire, and of famine. The very magnitude of the event prevented the exaggeration of its horrors.

Considering the disastrous nature of earthquakes, it is not surprising that they have been studied from early times. Records are extant of shocks which took place long prior to the Christian era, and by the second century the scientific inhabitants of Japan had devised instruments for the automatic registration of such phenomena. These early types of apparatus were merely rudimentary seismoscopes, that is to say, they only recorded the occurrence of a seismic disturbance in their locality, and gave no information as to its character. The great earthquake which destroyed Lisbon in 1755 resulted in further attention being directed to the study of seismology. For it had been observed that the effects of an earthquake of such power could be indirectly traced over the whole world by the movement of the bubbles in delicate spirit levels, by the oscillation of the water in lakes, or by the motion of stars in the field of view of a telescope. The Japanese were again the pioneers in this extended sphere of investigation, and instruments for registering teleseismic disturbances have now been in use for nearly thirty years. The apparatus employed at the present time is of a greatly improved type, and does not merely record

the occurrence of an earthquake but gives a continuous record of the movements of the ground from the commencement to the end of the motion.

Seismometers or seismographs, as these instruments are called, may be roughly divided into two great classes according to the main principle of their action. These we shall designate as (i) steady-point instruments, and (ii) goniometers or tilt-measurers. The action of both types may be illustrated from Fig. 1. AB represents a metal bracket carrying an axle CD pivoted freely at C and D, and the bracket is so fixed that CD is vertical. At O, a point in CD, a long arm OP is rigidly attached at right angles

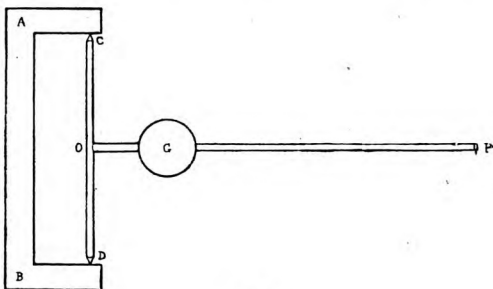


FIG. 1.

to CD. At some point of this horizontal arm near to O is fixed a heavy mass G. The arm OP will be in neutral equilibrium as the gravitational forces and the reactions at C and D have no moment about the vertical axis CD. Suppose now that AB receives a sudden small horizontal displacement, that is at right angles to the plane of the paper. To fix our ideas, let us suppose that AB comes forward. O will therefore also come towards us, but in consequence of the inertia of the mass at G, the point G will remain practically stationary, and the other end P of the horizontal arm will move away from us. Hence the motion of P is in the reverse direction to that of AB, and it is greater than AB's in the approximate ratio of GP to GO. If AB was fixed to the wall of a room, and if the sudden movement was that caused by an earthquake, then, G being a "steady point" in space, P

would move relatively to the floor beneath, which participates in the motion of AB. A pencil attached to P would therefore give a record on a sheet of paper supported from the floor, and if this paper was gradually carried by clockwork in the direction of OP a continuous record would be obtained of the displacements of P, that is, a magnified record of the displacements of AB.

It will be noticed that a series of movements of AB in the same direction would result in a large deflection of P from its initial position, and to prevent this "wandering" of the horizontal arm, the axis CD is not made truly vertical, but is slightly inclined so that OP droops to a very small extent. After a sudden displacement OP accordingly will swing back towards its initial (and equilibrium) position.

Such is the principle of the "steady-point" seismograph. Suppose now that with CD inclined to the vertical as described above we keep D fixed while C moves as before through a small distance forwards or backwards. We have then tilting of the axis CD in a plane at right angles to OP, and OP will consequently swing as in the previous case. We may take a simple illustration of such a movement. Imagine a bookcase or cabinet which is not perfectly upright but is slightly tilted forwards. If one of the doors is unlocked it will swing open and come to rest pointing straight out at right angles to the bookcase. If now we raise either end of the bookcase the door will swing towards the opposite end. This is the mode of action of a seismograph of the goniometer or tilt-measurer type.

It is clear that neither the goniometers nor the steady-point instruments can give records of displacements in the vertical plane through the boom OP. To get complete seismic records at any station we therefore require two such horizontal pendulums at right angles to one another and a third instrument to record vertical displacements. (This last mentioned is of less importance, and we shall not refer further to it.)

Seismographs then are classed as steady-point instruments or goniometers according to the *predominating* principle in their mode of action, for in general they are actuated to a greater or less degree in each manner.

As a typical form of seismograph we shall consider the Ewing-Gray-Milne instrument, the essential features of which are shown in elevation and plan in Fig. 2.

On a solid masonry pier A stands an iron bed plate B, with three levelling screws, carrying an upright C. From this the aluminium boom DE, about three feet in length, is suspended by means of a tie FG. The end D of the boom has an agate cap with a hemispherical concavity which rests against an adjustable pivot H. In order to give the boom stability and to make the

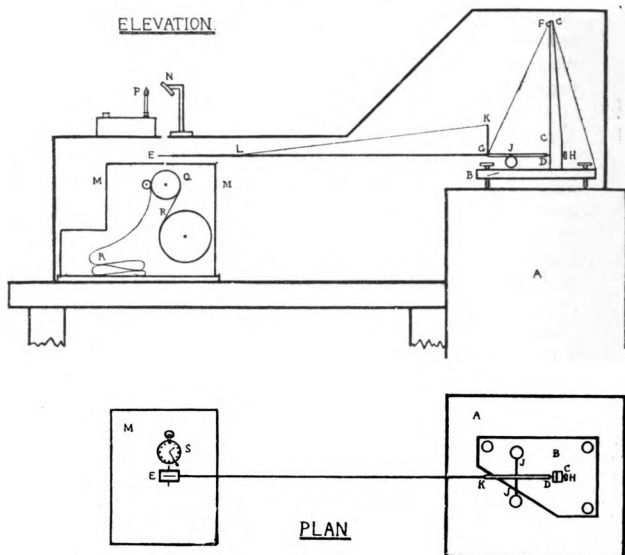


FIG. 2.

thrust at D horizontal, two small weights depend from a short cross bar JJ. To prevent flexure of the boom a small upright GK is connected by a tie to the point L. At the outer end of the boom a small horizontal plate of blackened mica E is attached having a slit in it cut parallel to the length of the boom. This plate floats over the top of a box M in which there is another slit at right angles to the first. A mirror N reflects the light from a lamp P down into this box. The light enters the box in a narrow beam

at the point of intersection of the slits and falls on a strip of sensitised paper RR drawn by clockwork over a cylinder Q. Light also enters beyond each side of the floating plate, and so the record given when the boom is at rest consists of a thin central line and two broad marginal bands. If the boom is oscillating the central line and marginal bands will give a picture of the motion. A watch S, with a specially long minute hand, gives time signals on the sensitised film by cutting off the light from one marginal band once each hour. In the older and still more generally used type of the Milne instrument, the paper moves at the rate of about one millimetre per minute, which is too slow to give an open record.

Fig. 3 is the seismogram of the San Francisco earthquake obtained at the Coats' Observatory, Paisley.¹ It will be observed that the movement of the boom gives a broadening of the central trace and not a sinuous line.

On the continent seismographs are used which go to the opposite extreme from the Milne apparatus. Instead of employing a lightly built instrument, a weight of as much as 17 tons may be used, as in the Wiechert pendulum, to give a steady point. Multiplying levers are then attached to this recording point so that a magnification up to some 2200 times has been attained. The great inertia of the large mass renders negligible the effect of the friction of the supports and recording levers. The Milne instrument has, however, many important advantages in respect of low initial outlay, small cost of upkeep, economy of space, and requiring little attention.

An examination of a Milne record of an earthquake (see Fig. 3) reveals waves of four types:—

- (i.) The preliminary tremors or first phase waves. These are indicated by a slight thickening of the central trace.
- (ii.) The second phase waves. These are more effective in producing motion of the boom, and are therefore conspicuous both on the central trace and the marginal bands.
- (iii.) The large waves, which in many cases produce motion of the boom across the whole breadth of the sensitised paper.
- (iv.) The concluding vibrations which are of smaller extent.

¹ Reproduced by permission of the Coats' Observatory Committee.

Our knowledge of the nature of these vibrations is chiefly obtained from a study of their rates of propagation. It is found that the large waves take about 57 mins. to travel from a seismic centre to a station situated at a distance of 90° , and 113 mins. to travel to the antipodes. Thus the time taken is approximately proportional to the arcual distance, and the waves appear to travel with a uniform velocity of about 1.85 miles per second round the surface of the earth. The preliminary tremors on the other hand reach a station at 90° distance in about 13 mins., but take only about 18.5 mins. to reach the antipodes. If they travel along the surface then their velocity undergoes acceleration. No explanation could be given of such an acceleration. If we assume that the waves travel along chords in the earth's surface, then the variation in the velocity depending on the length of the path traversed is found to be less marked although not entirely absent. This is shown by the following table, calculated on the assumption that the waves are propagated along the chords and with the same constant velocity along all chords of equal length.

Table showing relation between average velocity and path length for the preliminary tremors.

Arcual distance of observing station from seismic centre.	Apparent velocity of wave propagation along the chord.
10 degrees.	2.5 miles per sec.
30 ,,	6.2 ,, ,, ,,
60 ,,	6.8 ,, ,, ,,
90 ,,	7.2 ,, ,, ,,
120 ,,	7.5 ,, ,, ,,
150 ,,	7.6 ,, ,, ,,
180 ,,	7.6 ,, ,, ,,

The only difference between the long and short paths in this case, in addition to that of mere magnitude, is the depth to which they penetrate. We are thus led to the conclusion that these tremors in their passage deep down in the earth are travelling in a medium which transmits them with greater rapidity.

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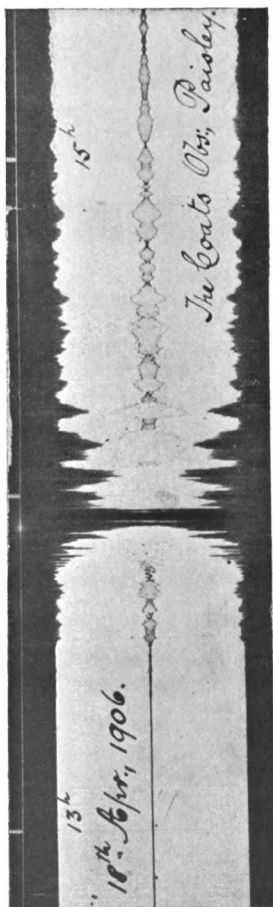


FIG. 3. SAN FRANCISCO EARTHQUAKE.

A similar state of affairs obtains in the case of the second phase waves, and so they were early suspected of pursuing paths through the earth and not along its surface.

The view which at present receives most general acceptance is as follows:—

The large waves travel along the earth's surface, the crust rising and falling under the action of elastic and gravitational forces, and "behaving in a manner similar to a sheet of ice on an ocean swell." The first and second phase waves travel along paths closely approximating to chords, but slightly curved in consequence of refraction on passing through media of varying elastic properties. The large velocities of 7.5 to 7.7 miles per sec., which the preliminary tremors attain in the earth's interior, point to a high rigidity modulus for the terrestrial globe. The approximately uniform average speed of these waves over the 60 to 180 degree chords shows that the earth's core is fairly homogeneous, while the comparatively low speed attained on the 10° chord, as compared with the others, indicates that the surface crust is not more than some 30 miles in thickness. To account for the velocities given in the table, we must imagine a highly rigid and fairly homogeneous core extending upwards to within 200 miles of the surface and then very rapidly changing into the heterogeneous and imperfectly elastic material which constitutes the surface crust. It may be pointed out that this seismometrical estimation of the thickness of the earth's crust is in good agreement with determinations based on thermal considerations. The seismologist, too, can give for the internal core a specific gravity which meets the requirements of the physicist, the astronomer, and the geologist.

Adopting this theory of seismic wave propagation, we are led to consider the distinction between the first and second phase waves which pursue identical, or, at least, almost identical paths. If the earth be solid throughout and have therefore both elasticity of bulk and of shape, there are two varieties of elastic waves which may be propagated through it, viz., compressional and distortional waves. The velocity of the former is given by the expression $\sqrt{(E/d)}$, where E is the Young's Modulus of the material, and d is the density. The velocity of the distortional wave is $\sqrt{(n/d)}$, where n is the rigidity modulus. For surface rocks E is on the average about 4.5×10^{11} dynes per square cm, while n has about one-third of that value. Accordingly we should expect the velocities of

compressional and distortional waves along short chords (that is, along chords lying near the surface) to be about 2.0 and 1.3 miles per sec. respectively. Observation gives 1.8 for the first phase waves and 1.2 for the second phase. Considering then the difficulty of calculating the mean velocities in such heterogeneous and ælotropic material as the surface rocks, it is evident that the agreement is very good.

And now if we accept the first phase and second phase waves to be respectively the compressional and distortional elastic waves, we arrive at an important conclusion regarding the nature of the earth's interior. It must be solid throughout. For a fluid, be it liquid or gaseous, has no elasticity of shape, no rigidity modulus, and cannot transmit a distortional elastic wave. Under the immense pressures and high temperatures which are believed to exist in the earth's interior, solid, liquid, and gaseous portions of matter might reveal marked peculiarities in their properties, but the ultimate and fundamental distinction between a solid and a fluid remains as ever, that the former *has*, and the latter *has not*, elasticity of shape.

This variation of wave speed, according to the nature of the wave motion, is of great service to the seismologist. When an earthquake takes place at a great distance from his observing station, the preliminary tremors considerably outrun the second phase waves, while the latter arrive long before the large waves have come round their circular track. The time interval which elapses between the arrivals of any two of the phases gives a measure of the distance of the seismic origin, for it is the same for the same two phases in any equidistant seismic disturbances if we neglect the small total differences which may exist in the intervening rock material. Records of earthquakes obtained at three stations distant from one another are sufficient to give in general a comparatively accurate determination of the seismic origin.

There are, however, some causes which tend to make the seismographic record obscure and occasionally untrustworthy. A seismogram has almost invariably the different wave-portions superposed, the later second phase waves, for example, still arriving after the earlier large waves have commenced to influence the seismograph. Indeed, the concluding portion of a seismogram is an intensely complicated record of secondary disturbances, of large waves of the principal shock arriving by circuitous paths, and

of "echoes" or waves which have undergone internal reflection in the earth. Moreover the phenomenon of forced vibrations is present in a perplexing degree. If we have a pendulum consisting of a heavy weight—say one cwt.—hanging by a rod from a point of suspension, there are two ways of getting it to take up a large swing. We may either give it one vigorous push, or we may give a series of rhythmic impulses, timed so that their period is equal to, or bears some simple ratio to, the period of vibration of the pendulum. So with the seismograph. A large amplitude of movement of the boom may indicate either the arrival of waves of large amplitude or the arrival of a series of waves of period approximately equal to that of the instrument or simply related to that period. Such resonance effects are difficult to eliminate. In heavy instruments, like the Wiechert Pendulum, damping arrangements can be introduced, but such a procedure is out of the question in the case of light apparatus such as the Gray-Milne Seismograph.

Occasionally the recording point of a seismometer is found to move slowly but steadily for an hour or so in one direction. This indicates a change in the horizontal—a tilting of the whole surface of the ground—and has been ascribed to variations of atmospheric pressure. Suppose the boom of a horizontal pendulum to point north and south, and suppose that the barometric pressure is uniform over a wide surrounding area. If now the barometer rises to the west of the instrument and falls to the east, it has been conjectured that the earth's surface will be depressed in the west where the atmospheric pressure is increasing, and will rise in the east where the pressure is diminishing. This would give a tilt of the ground towards the west, and hence a movement of the boom in that direction. It is difficult to understand how the small variations in the atmospheric pressure can produce any sensible compression or expansion of rock material, yet there is good reason to believe that a horizontal pendulum has a tendency to swing towards an area of high barometric pressure. Out of 21 cases of large drift of a seismometer which have been investigated by the author, 12 showed a movement towards an anticyclonic area, in 5 cases no relationship was obtainable, and in only 4 did the seismometer move towards a cyclonic area. It should be noted that at seismological observing stations situated on steep ground, there is always the probability of considerable amount of tilting due to

rain, evaporation, and the percolation of water down the sloping soil strata.

As to the origin of seismic disturbances, many theories have been advanced from time to time. The volcanic theory, which was advocated by Aristotle and Humboldt, still finds favour in the popular mind, which is prone to look for connections between phenomena of such a disastrous nature. Yet there is very little scientific ground for supposing such a relation of cause and effect to account for many earthquakes. Doubtless many violent volcanic outbursts are accompanied by seismic disturbances, but these are neither of wide-extending influence nor great devastating power. Indeed the supporters of a volcanic theory of earthquakes are not agreed as to the exact way in which the relation manifests itself. Some say that the presence of volcanoes in a certain district shows that it is an area peculiarly liable to seismic disturbance. Others would regard the volcanoes as safety-valves which reduce the danger from internal convulsions.

If one enters on a chart of the world the positions of the great seismic centres, it is found that these may be grouped into several areas of high seismic frequency. One feature is observed to be common to all those regions, viz., that they are areas possessing steep gradients. Thus in the Cordillerean region we have gradients of 200 to 600 feet per mile extending over great distances, and in the Antillean region similar lengthy slopes of 300 to 1000 feet per mile. It is on the face or at the foot of such slopes that the most violent earthquakes originate. There seems little reason to doubt that the great majority of earthquakes are of tectonic origin; that they are caused by the formation of geological faults, or by further movement of the rock masses along the planes of existing faults. As to how these faults are produced we are not here concerned, although it may be remarked in passing that they are at least partly due to readjustments towards isostasy of the land masses (which state is continually altering through denudation, sedimentation and meteorological changes), and partly to the secular cooling of the earth.

In the case of many great earthquakes it has been possible to trace the fault concerned. Thus the great Mino-Owari earthquake of 1891, which affected an area of at least 100,000 square miles, was due to a fault about 70 miles in length, the throw at some places being as much as 13 feet. The San Francisco earthquake

had a similar origin, and there is no doubt that the recent Italian disaster is to be ascribed to the same cause. In Southern Italy we have a region whose configuration is very suggestive of great seismic activity. The gradients are steep. The mountain chains of southern Italy and the lofty peaks of Sicily are at no great distance from considerable depths in the Tyrrhenian and Ionian seas. There is continual alteration in progress. The basins of the two aforementioned seas are slowly sinking, the movement being most pronounced in the neighbourhood of the Straits of Messina. As this proceeds the strain on the adjoining rock strata increases, and finally, when the elastic limit is exceeded, fracture takes place with a consequent earthquake shock. The strain is relieved for the time being, but as the movement continues there is of necessity a repetition of the disturbance. As proof of the occurrence of such dislocations, we have the two great known faults in the Messina Straits. The first enters the strait running in a north-westerly direction, passes the town of Reggio, and continues by way of Monteleone to the valley of the Crati. The second skirts the eastern coast of Sicily, passes close to Syracuse, Catania and Messina, and there abuts on the other fault. The downthrow of the Calabrian fault is towards the west, while that of the Sicilian fault is towards the east. The triangular wedge of rock between the two is slipping down from time to time, and thus produces the series of shocks which at intervals shakes the Calabrian and Sicilian district. The nature of the ground increases the destructive power of the earthquakes. Messina, Reggio, and the neighbouring towns are all built on loose gravel, clay, and sandy beds, which lie on the firm granitic rocks of the Apennine range. When, in consequence of a dislocation of the solid rock, elastic waves are propagated outwards through the material, there is a great increase in amplitude of the waves on passing into the loose and heterogeneous surface strata. Secondary disturbances are set up and a simple wave motion is converted into a violent vorticose and erratic vibration of large amplitude that no building can withstand. The seismologist has pointed out the dangers of this area, but if his warnings are unheeded, there is unfortunately every reason to fear that the disasters of 1783 and 1908 will be repeated in future years.

In conclusion, we will refer to an interesting variation in seismic frequency. From careful and frequent determinations of latitude

made at widely separated observatories, it has been found that the axis of rotation of the earth does not maintain a fixed position in the earth's mass. The poles are moving in erratic paths but never departing more than some 30 feet from their mean position. If a map is constructed showing the pole's path for any given period and marks are placed on it indicating the various positions it occupied when great earthquakes occurred, it will be observed that these marks tend to cluster round the sharp bends in the path. Suppose we note the times at which the curvature of the path is greatest, and take three successive 73-day periods, the middle of the second coinciding with the time of maximum inflexion of the polar path. On counting the number of earthquakes registered in each period, it will be found that the second is the one of greatest seismic frequency, while the third is superior to the first. Of 603 violent shocks so analysed by the author, 148 belonged to the first period, 276 to the second, and 179 to the third. Two conclusions can be drawn from this—(i.) that large earthquakes are associated with polar displacements (the bond of union being probably the gyrostatic action of the rapidly rotating earth), and (ii.) that changes in the direction of the polar movement produce earthquakes rather than that the molar displacements occurring in large earthquakes alter the earth's axis of rotation.

In the course of a single lecture it is quite impossible to treat any one branch of science with justice. What has been attempted here is merely to indicate some of the phenomena with which seismology is concerned, and to point out a few directions in which it is now successfully pursuing its investigations. One is apt to decry the seismologist because as yet he cannot give us sure and timely warning of approaching disaster. Yet even in this direction something is being accomplished, and the future is bright with promise. And just as the meteorologist cannot foretell all the storms of the coming month, but can at least instruct our captains how to navigate their ships when caught in the hurricane, so the seismologist has taught us, and is further teaching us, how to minimise those disasters which suddenly sweep over areas of our globe.

[The lecture was illustrated by a full scale model of the Gray-Milne Seismograph, by seismograms obtained with various instruments, and by a series of lantern slides illustrating the recent disasters in San Francisco, Valparaiso, Jamaica, and Messina.]

On Reversible Conditions brought about in Magnetised Steel by Alternate Cooling and Warming. By JAMES G. GRAY, B.Sc., F.R.S.E., Lecturer on Physics in the University of Glasgow, and HUGH HIGGINS, M.A., Thomson Experimental Scholar in the University of Glasgow.

[Read before the Mathematical and Physical Section,
23rd February, 1909.]

It has been shown by Messrs Dewar and Fleming¹ that if a specimen of iron or steel is magnetised to saturation at room temperature and then alternately cooled and warmed between 0°C. and -190°C. (the temperature of liquid air) the specimen is brought into a condition in which its magnetic moment at -190°C. exceeds that corresponding to 0°C. by a definite amount. It was found that the effect of the first cooling was to reduce the magnetic moment; on allowing the specimen to warm to 0°C. a further reduction in the magnetic moment took place. On cooling the magnet once more its magnetic moment increased, and from this stage the magnetic moment of the specimen at -190°C. always exceeded that of the specimen at 0°C. by an approximately constant amount.

In the experiments of Dewar and Fleming the specimens were magnetised initially at room temperature. It occurred to the authors to repeat the procedure, starting with the specimens magnetised to saturation at the temperature of liquid air. It was found that the changes brought about by the temperature treatment were even more remarkable than those which were observed by the aforementioned investigators.

The method of experimenting was as follows:—A short bar of the material to be examined was placed within a glass tube bent up at one end to admit liquid air. The end of the tube through which the specimen entered was closed by means of a cork, and the tube then thoroughly wrapped up in cotton wool. It was

¹ *Proceedings of the Royal Society of London*, Vol. LX., p. 57.

placed between the pole-pieces of a powerful electro-magnet and the specimen thus magnetised to saturation at room temperature; the tube was next withdrawn, mounted on a magnetometer bench in the ordinary way, and the magnetic moment of the specimen measured under the following conditions :—

- (1) at room temperature immediately after being magnetised.
- (2) after being cooled to -190°C .
- (3) after warming to room temperature.
- (4) after cooling once more to -190°C .

And so on. This is the procedure of Dewar and Fleming.

The tube was now withdrawn, placed between the poles of the electro-magnet, and the specimen cooled to the temperature of liquid air. After having been magnetised at this temperature it was once more mounted on the magnetometer and its magnetic moment measured—(1) at -190°C . immediately after being magnetised; (2) after warming up to room temperature; (3) after being cooled to -190°C ., and so on.

The experiments were extended to various specimens of iron, steel and nickel. The nature of the results obtained was the same for all these materials, and it is proposed to publish only those yielded by two varieties of steel. These two specimens had the composition shown in the following Table. They were examined in the unannealed, annealed and quenched conditions.

TABLE I.—Dimensions and Chemical Compositions of Specimens Employed.

Description of Material.	Length of Specimen.	Diameter of Specimen.	Mass in grammes.	Percentage Composition.				
				Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
Steel Wire	7.7	0.27	3.36	0.755	0.660	0.667	0.017	0.027
Special Hard Steel	7.2	0.96	40.0	1.321	0.339	0.143	0.023	2.745

Results for Steel Wire.—The results obtained on testing this material are shown in Tables II., III. and IV. below.

TABLE II.—Steel Wire in Forged Condition.

Magnetised at 15°C.		Magnetised at -190°C.	
Temperature.	Magnetic Moment in c.g.s. units.	Temperature.	Magnetic Moment in c.g.s. units.
15°C.	119	-190°C.	144
-190°C.	96	15°C.	80
15°C.	85	-190°C.	90
-190°C.	92	15°C.	75
15°C.	76	-190°C.	85
-190°C.	83	15°C.	73
15°C.	73	-190°C.	83
-190°C.	79	15°C.	73

TABLE III.—Steel Wire in Annealed Condition.

Magnetised at 15°C.		Magnetised at -190°C.	
Temperature.	Magnetic Moment in c.g.s. units.	Temperature.	Magnetic Moment in c.g.s. units.
15°C.	70·0	-190°C.	77·4
-190°C.	41·5	15°C.	27·2
15°C.	33·0	-190°C.	37·3
-190°C.	34·4	15°C.	26·3
15°C.	30·0	-190°C.	36·4
-190°C.	31·6	15°C.	26·0
15°C.	30·0	-190°C.	36·0
-190°C.	31·5	15°C.	26·0

TABLE IV.—Steel Wire after Quenching at 900°C.

Magnetised at 15°C.		Magnetised at -190°C.	
Temperature.	Magnetic Moment in c.g.s. units.	Temperature.	Magnetic Moment in c.g.s. units.
15°C.	189	-190°C.	190
-190°C.	184	15°C.	160
15°C.	178	-190°C.	163
-190°C.	179	15°C.	159
15°C.	178	-190°C.	163
-190°C.	179	15°C.	159
15°C.	178	-190°C.	163
-190°C.	179	15°C.	159

It will be seen that for all three conditions of the material, the effect of the first cooling upon the specimen, after being magnetised at room temperature, was to bring about a considerable reduction in its magnetic moment; on the specimen warming once more to room temperature a further reduction in the magnetic moment resulted; and the effect of the second cooling was to increase the magnetic moment. The specimen was now in a reversible condition in which its magnetic moment at -190°C. exceeded that at 15°C. by an approximately definite amount. The results obtained were thus similar to those observed by Dewar and Fleming.

Starting with the specimen magnetised at -190°C. the effect of the first warming upon the specimen was to diminish the magnetic moment; on cooling the specimen to -190°C. its magnetic moment increased. The magnet was now in the reversible condition described above.

The magnitudes of the changes brought about by the treatment is particularly great in the case of the annealed specimen. It is also interesting to notice that for the reversible conditions of the specimen the increase brought about by the cooling is much greater in the case where the specimen is magnetised at -190°C. than for that where it is magnetised at 15°C. Thus for the annealed specimen in the reversible condition after being magnetised at 15°C. the magnetic moment at -190°C. exceeds that for 15°C. by

about 5 per cent., whereas starting with the specimen magnetised at $-190^{\circ}\text{C}.$ the magnetic moment at $-190^{\circ}\text{C}.$, once the reversible stage has been reached, exceeds that for $15^{\circ}\text{C}.$ by about 40 per cent.

The results obtained on testing the specimen of hard steel are set out in the following Tables.

TABLE V.—Special Hard Steel in Forged Condition.

Magnetised at $15^{\circ}\text{C}.$		Magnetised at $-190^{\circ}\text{C}.$	
Temperature.	Magnetic Moment in c.g.s. units.	Temperature.	Magnetic Moment in c.g.s. units.
$15^{\circ}\text{C}.$	274	$-190^{\circ}\text{C}.$	320
$-190^{\circ}\text{C}.$	248	$15^{\circ}\text{C}.$	209
$15^{\circ}\text{C}.$	174	$-190^{\circ}\text{C}.$	304
$-190^{\circ}\text{C}.$	241	$15^{\circ}\text{C}.$	198
$15^{\circ}\text{C}.$	171	$-190^{\circ}\text{C}.$	294
$-190^{\circ}\text{C}.$	240	$15^{\circ}\text{C}.$	195
$15^{\circ}\text{C}.$	165	$-190^{\circ}\text{C}.$	290
$-190^{\circ}\text{C}.$	233	$15^{\circ}\text{C}.$	192

TABLE VI.—Special Hard Steel in Annealed Condition.

Magnetised at $15^{\circ}\text{C}.$		Magnetised at $-190^{\circ}\text{C}.$	
Temperature.	Magnetic Moment in c.g.s. units.	Temperature.	Magnetic Moment in c.g.s. units.
$15^{\circ}\text{C}.$	145	$-190^{\circ}\text{C}.$	199
$-190^{\circ}\text{C}.$	88.7	$15^{\circ}\text{C}.$	62.6
$15^{\circ}\text{C}.$	65.7	$-190^{\circ}\text{C}.$	105.0
$-190^{\circ}\text{C}.$	80.8	$15^{\circ}\text{C}.$	56.4
$15^{\circ}\text{C}.$	63.0	$-190^{\circ}\text{C}.$	98.5
$-190^{\circ}\text{C}.$	78.0	$15^{\circ}\text{C}.$	53.3
$15^{\circ}\text{C}.$	62.0	$-190^{\circ}\text{C}.$	95.4
$-190^{\circ}\text{C}.$	77.0	$15^{\circ}\text{C}.$	52.0

TABLE VII.—Special Hard Steel in Quenched Condition.

Magnetised at 15°C.		Magnetised at -190°C.	
Temperature.	Magnetic Moment in c.g.s. units.	Temperature.	Magnetic Moment in c.g.s. units.
15°C.	300	-190°C.	334
-190°C.	188	15°C.	184
15°C.	134	-190°C.	234
-190°C.	156	15°C.	184
15°C.	130	-190°C.	233
-190°C.	152	15°C.	185
15°C.	128	-190°C.	233
-190°C.	150	15°C.	184

It will be seen that the results obtained on testing this variety of steel are very similar to those yielded by the specimen of steel wire. For the material in the annealed condition, after having been magnetised at room temperature, the effect of the first cooling upon the specimen was to reduce its magnetic moment by about 40 per cent. ; on allowing the specimen to warm to room temperature its magnetic moment was further reduced by about 26 per cent. From this stage the magnetic moment at -190°C. always exceeded that corresponding to room temperature by about 23 per cent. Starting with the specimen magnetised at -190°C. the effect brought about in the specimen by the first alteration in the specimen was to reduce its magnetic moment by about 70 per cent. From this stage the magnetic moment at -190°C. always exceeded that at room temperature by about 70 per cent.

The Principles of Municipal Taxation. By JAMES MUIRHEAD.

[Read before the Society, 27th January, 1909.]

WHATEVER view we may take of the proper sphere of Municipal management and the limits within which collective operations are possible or desirable, the laying of taxes of greater or less amount on the community is a necessary condition of anything being done by the Municipality, and the question of the best and fairest method of raising the necessary funds is one of great importance. In a primitive community, the simple method of a Poll Tax upon every member would no doubt suffice. A further stage is marked by the expedient of Market or Customs dues, and the third or final stage is when an attempt is made to collect a tax upon every inhabitant, proportioned either to his means or to the extent to which he derives benefit from the municipal services. An income tax would no doubt be theoretically the fairest mode of doing so, but if we leave out of account various unsuccessful attempts that have been made to assess local taxes upon "means and substance," the practical difficulties in the way of such a tax are such as to put it out of the question. The Imperial Income Tax is based both upon local situation of the source of income and domicile of the tax payer. Thus the income from consols or other home investments is taxed though the owner may be a foreigner or be resident abroad, while a resident in this country has to pay tax on his income not only from home but from foreign investments or businesses. Such a system could hardly be applied to local taxes. For every Municipality or Local Authority to tax both the income derived from property or businesses locally situated or carried on within its limits, whether the owner was resident there or not, and at the same time to tax its residents on their income derived from sources outside the boundaries, would amount to a great deal of double assessment. The system actually followed, and now universally adopted, is that of selecting one form of property as a basis—a kind of property which has a local situation, is immovable, cannot be concealed, and possesses an easily ascertainable

value. It is based on the theory that the annual value of the house in which each inhabitant resides, and of the shop or other place of business where he makes his livelihood, is a fair index of his ability to pay taxes, and of the demand of himself and his customers upon the common resources. In the case of his house, he pays directly in respect of the personal benefits which he and his family and servants derive. In the case of his shop, he pays partly for this, and also indirectly on behalf of his customers to whom he adjusts the price of his goods in view of all the burdens which are placed on his business. Whether this system is an ideally perfect one, we need not stop to enquire. It is the system which at present holds the field, and no substitute has been suggested which would not infer greater disadvantage and injustice than are chargeable against it. It has the merit of having a basis which is obvious and tangible, and which can be arrived at in the case of every individual without the necessity of enquiry into his private affairs. It has the further merit of being based, in the vast majority of cases, upon a rent fixed by the assessed person himself by bargain in the open market, rather than upon a hypothetical valuation. The question to which I confine myself is whether the present method of carrying into effect this system could not be greatly improved from the points of view of economy, convenience, and fairness to all concerned, to which I propose to add a few words of criticism upon proposals which have been recently much discussed.

A good deal of the confusion of ideas with which the whole subject has sometime been discussed, has arisen from the supposed antagonism of interest between landlord and tenant, raising the question of the justice or injustice of making the landlord pay more or less than the tenant, or *vice versa*, and it seems necessary at the outset to consider the question of who really pays the taxes, and who really benefits by the municipal services for which they are levied. In a progressive town where the population is always more or less pressing up to the limits of the existing house accommodation, and where at the same time old houses—from decay or alteration of circumstances—are ceasing to be occupied, it is obvious that capital for the erection of new houses will only be attracted by the prospect of obtaining rents sufficient to provide for all the risks attendant on the ownership of property, such as taxes, fire, repair, decay, risk of empty houses, and the like, and to

yield a return upon the capital of an amount equivalent to what can be obtained from other forms of investment. If taxes are imposed upon the landlord, these must obviously be taken into account, and unless there remains after paying those the proper return necessary to attract capital, new houses will not be built, and this will continue until rents, by increase of the demand, have risen to the point to attract capital—in other words, until the tenant has agreed to pay the taxation which has been imposed on the owner. So far, therefore, as the owner is concerned, it is in the long run a matter of indifference whether the tax is imposed on him or the tenant in the first instance. Sooner or later the taxation must become an element in the price of the house to the tenant, that is, in the rent. A purveyor of houses is in the long run in no different position from a purveyor of any other sort of goods. The State, in imposing upon the tobacco importer a duty upon his imports, does not thereby intend to make him pay the duty out of his own pocket. The person struck at is the ultimate consumer, and it is not otherwise with the purveyor of houses.

It is said, however, that the owner of house or other property, as owner, derives a benefit from the municipal service, separate and distinguishable from that of the occupier, and that consequently it is just that a certain portion, at least, of the taxation should fall upon him. This benefit is said to consist, say, in such matters as the protection afforded by the Police to his property, the provision of sewers and maintenance of roads of access, it being maintained that a house with good protection and with a good access and means of drainage is of more value to the owner than one which does not possess these advantages. All that is true, but then to the owner who is not himself occupying his house, these advantages are only of use in the shape of his obtaining from the tenant a larger rent, and to the tenant it matters little whether he pays for them direct to the Municipality or in the shape of an increased rent to his landlord. It follows from all this that, in the end, the municipal service must be paid for by those who actually use and enjoy it—that is to say, the persons actually resident or using business premises in the town, in which term must of course be included those who, though not actually tenanting premises, do business as purchasers of goods or otherwise with the shopkeepers or other traders.

It is, however, sometimes maintained that a new tax imposed

on the owner will not be transferred to the tenant, for the reason that the owners of unbuilt land, finding that builders will not take up their land at the current price owing to the new taxation, will reduce their price so as to enable builders to erect houses rented on the existing scale, and still to pay the new taxation, and that the new tax will thus fall upon the ground owner in the case of new tenements, and on the owner of the whole property in the case of the old tenement. No doubt the anxiety of ground owners to get builders to take up their ground is an element to be considered in every investment in property, and any cause which prevents building will tend to reduce the price of ground. But this element is always present, apart altogether from the question of taxation, and is one of the risks which an investor in property must face, and it by no means follows that every falling-off for a time in the demand for land will produce a fall in the price. Land owners in a town cannot be regarded as the owners of a commodity which has cost them nothing, and the price of which they can at any time reduce without loss to themselves, apart from all question of what they may have spent on the ground in rendering it fit for building purposes. Merchants and manufacturers do not to any great extent sell the commodities they have produced or have purchased at a loss, and a dealer in land is in no different position. Indeed he is less likely voluntarily to sell at a loss than dealers in perishable goods, as from the nature of the speculation he has entered into in purchasing his land, he must have made up his mind that he would probably have to hold it for a considerable time before realising at a profit. Moreover, the price of the land in the case we are considering is a comparatively small element in the rental. In Glasgow land for the erection of flatted tenements, such as the vast majority of the population inhabit, can be had almost anywhere in the districts adapted to such dwellings at about ten shillings per square yard or less. A tenement of twelve houses can be put up on 350 square yards costing £175, or at 4 per cent., £7 per annum. The average rent of each of these houses will be about £9, of which the ground value will be thus only about twelve shillings per annum. Now a tax of, say one shilling a pound on this rental, or nine shillings upon each house, could only come to fall on the ground owner if he was prepared to sacrifice three-fourths of the price of the ground, accepting from each house three shillings instead of twelve shillings. This or

course would be extremely improbable, and we may conclude that at the best only a very small proportion of any new tax could in this way come to fall upon the ground owner, and that in the end practically the whole of it would fall upon the occupying tenant.

These observations seem necessary as a preliminary to considering the remedy I am about to suggest for some of the evils admittedly attendant upon the present method of collecting taxes. In the City of Glasgow there are two main taxing authorities, the Corporation and the Parish Councils. Leaving water rates out of account, the Corporation collect from occupiers of premises of £10 and upwards a gross amount of nearly 3/- per pound, and from owners about 1/- per pound. The Govan Parish Council for poor and school purposes levy over a large part of Glasgow about 1/4 from occupiers and 1/3 from owners, and the City Parish Council over another portion of the area levy somewhat similar amounts. In all three cases, so far as occupiers are concerned, this implies the making up of an assessment roll containing an enormous number of small calculations, the filling up in each case of a schedule and the delivery of these to each occupier, the provision of offices and sufficient staff for the collection of all these small sums, the sending out of dunning notices to those who do not pay, and finally the loss of a large amount of the money through defaulters—the expense of prosecuting for these being in many cases in excess of any sum likely to be recovered. In regard to owners, though the number is not so great, there is to a large extent a duplication of what takes place in the case of occupiers. The City Parish and the Govan Parish, throughout their respective areas, have to do exactly the same work, not to mention other Parochial authorities who levy within various areas, consequently there are at least three sets of officials, six assessment rolls, six sets of assessment papers and six separate collections of taxes, where one organisation on a proper basis would do the whole work more efficiently and with an almost absolute absence of leakage. It is an axiom of all forms of Imperial taxation that the taxes should be collected as near the fountainhead as possible. That is why income tax is deducted from the dividends and interests, and why the Government exacts the whole duty from the tobacco importer when he takes his material out of bond instead of making each consumer pay it when he buys a cigar, yet in the case of municipal taxation we go upon exactly the opposite principal by endeavouring to exact small sums

once a year from each individual householder, the ultimate consumer. The cost of collection and the chance of evasion always increase the further we get from the fountainhead.

An incidental disadvantage is that on account of the amount of trouble and expense involved in making the collection, it is only possible to collect once a year. Now the average working-man does not understand the demand which comes at so long an interval. In making up his budget, his vision is limited to a week, a fortnight, a month, or at most a quarter, and a demand coming upon him once a year finds him unprepared, and even where he does manage to make the money forthcoming the claim is felt to be grievous and almost intolerable, whereas if the same amount were levied weekly, monthly, or even quarterly, the payments would be scarcely felt.

The remedy for this state of matters is based upon the recognition of the fact that it is immaterial whether taxation is primarily imposed on the owner or the occupier, or indeed is imposed in the proper sense upon a person at all. In taxing tobacco or other imports, we impose the duty upon the goods themselves. Our claim is what lawyers term one *in rem*. We say to the tobacco owner, you may pay duty upon your tobacco or not as you like, but if your stuff enters the country it can only do so upon condition of so much being paid to us. If this is not paid, we seize your tobacco as soon as you attempt to land it. Now, a municipal taxing authority should say practically the same thing. Each piece of property in the city should have allocated upon it in one sum its fair share of municipal taxation, according to its rent or annual value, which should be a first charge upon the property, preferable to all holders of feuduties or bondholders, and it should be left to those whom it may concern—that is, to the owner—to see that it is paid. If he fails to pay, his property is liable to seizure and to be sold in the open market, and he must adjust his rents on such a scale as will produce a revenue to cover this as well as the other charges on his property and leave him the necessary return. As we have seen before, the operation of the ordinary laws of supply and demand will soon adjust themselves to the altered circumstances, and each occupier in the end will pay his fair share of the burden.

The advantage to the Municipality will be that there will be no loss by leakage or non-payment. The whole amount levied will be collected to a penny. The advantage to the tenant will be that

he will be freed from a yearly demand coming upon him, usually at the commencement of the winter months, when payment is most difficult, and his taxes will be paid by him in the form of a small and scarcely felt addition to his weekly, monthly and quarterly rents.

Nor will there be any injustice to the owner. The cost of collecting a small addition to his rents will be infinitesimal, amounting at best to two or three per cent. commission paid to his factor on the excess amounts collected, and even then will not fall upon himself, but in the end become one of the elements upon which the rent is based and be therefore paid by the tenant. And this will also be the case as regards the proportion which he will lose through absconding tenants. The loss by non-payment under the present system is of course, to some extent, from occupants of houses who are able to pay neither rent or taxes, but to a far greater extent through the impossibility of recovering small sums of taxes from persons who nevertheless manage to keep a roof over their head by squaring their landlord. A man who pays his rent, but not his taxes, may manage to get along quite comfortably for a considerable time, whereas one who does not pay his rent very soon ceases to be a householder.

A system such as is suggested, would render very easy the further simplification of having only one collecting agency over the whole city area. If the city collector is informed of the gross rate to be levied respectively by the Corporation and the Parish Councils, and if he has only to divide this gross rate over the different properties in the areas respectively chargeable, it is a comparatively simple matter to make up the Assessment Roll and to issue the necessary notices to the owners. Under the tenement system in vogue in Glasgow, there is rarely more than one owner of a tenement forming one number in the street and occupied by say from eight to sixteen occupiers, and the same is the case with regard to blocks of business premises. The whole work, therefore, is reduced in the proportion of between eight and sixteen to one, and this extends throughout the whole machinery of sending out notices and collection. By getting rid again of the three collecting agencies, the work is again reduced by two-thirds, and if to this is added the saving of loss by non-payment, it will be seen that the benefit to the community at large will be very considerable.

(Reference was then made to the question of taxing unlet property, the conclusion being that exemption should not be granted on account of vacant property.)

When we have reached this stage, however, we arrive at the further and more difficult question of what is to be done in the case of ground wholly unoccupied with buildings, and also in the even more difficult case of ground occupied only with temporary buildings, or with buildings which do not represent the best use that can be made of the ground. Is it reasonable that such ground should be assessed not at the actual rent which it is yielding or is capable of yielding in its actual condition, but at the rent which it might yield if it were occupied either in the most profitable manner or by the average class of buildings erected upon similar ground, or, to put it otherwise, at a percentage on its market value? Such vacant ground is either held (though this is a comparatively rare case in Glasgow and other large cities) by the proprietor or representatives of the proprietor of ground originally forming a rural subject, which by the coming into existence of the community or its increase has acquired an urban character, or it is held by persons who have acquired it at a comparatively recent date as a speculation, either with the view to utilising it themselves for building purposes or reselling at a profit. The former case is, of course, the one that is held up by the advocates of what is called "Taxation of Land Values" as the typical one, but I believe that at the present day it is quite the exception, and that in this country the so-called unearned increment of Land Values has long ceased, except in exceptional cases, to be enjoyed by the present possessors of vacant land. Most of the present owners have acquired the land by the payment of prices which include the great bulk of this increment, and the increment is in the pockets of persons who have long ceased to have any connection with the land in question. For instances of such increment actually occurring we must go to new countries, such as Canada and the United States, where the springing up of new towns upon virgin soil is of common occurrence.

(Reference was then made to the springing up of new towns in the United States and Canada, and it was shown that unless by taxing equally all ground built or unbuilt on it would be impossible to provide the municipal service necessary to enable the town to grow.)

In the more complicated state of affairs which we find existing here, where the towns have been the growth of centuries, and municipal service has been going for a long time, the justice of assessing vacant ground may not be so obvious, but the root principles seem to be the same. The whole area, built upon or unbuilt upon, is the object of the municipal services. The ultimate occupier of the unbuilt ground will enjoy the benefits of the past expenditure on sewers, street formation, lighting, &c. Instead of being the occupiers of prairie land without necessary conveniences ready to their land, they will be the occupiers of lots ready to be built upon and with all necessary conveniences provided, and for this they will pay in the price of their land.

I would avert shortly to the question of the Taxation of Land Values. This is a proposal of a totally different character to those we have been considering. What is aimed at in it is not the apportionment of the municipal burden in the most convenient and equitable manner among the inhabitants of the town, but an attempt to recover for the community, wholly or partially, the difference between the prairie and agricultural value of the land occupied by the town and its present value, and this object is proposed to be attained by placing a separate value on the land and the buildings occupying it, the former value being the subject of a special tax. It does not matter, for the sake of present argument, whether this tax is two shillings or twenty shillings a pound on the annual value—the principle is the same.

In the first place, it is obvious that, except in rare cases, this tax would not fall upon the person who had really benefited by the increment. In the case of Glasgow, for example, the great bulk of the properties have changed hands during the last century many times. No doubt a comparison between the price paid at the time of the earliest transfer and the latest will show a considerable difference, but that difference has gone by instalments into the pockets of perhaps a dozen successive owners, and very likely the present owner would have difficulty in realising to-day the price he paid for the property twenty years ago. The unearned increment is not therefore in his pocket. On the contrary he is the person who has disbursed it, and is trying to get from his tenants to-day a return which will afford him interest on the money he has sunk. An attempt, whether by progressive taxation or otherwise, to make the present owners liable for this supposed increment, is simply

an attempt at confiscation. Of course there are those who hold that all accumulated capital ought to be expropriated in the interest of the whole community, and with these I am not arguing ; but if the principle of the right to property at all be conceded, it is obvious that an attempt to capture the profits made by men who are dead twenty, fifty or a hundred years ago is an impossible one, and the attempt to make the unfortunate owners of to day responsible would be in the highest degree unjust. We might as well call upon a person who has just paid a large sum for a picture by Reynolds or Gainsborough to pay again to the community the whole or a portion of the price, on the ground that by the growth of the community, and of the number of persons desirous of possessing such pictures while the supply of them was strictly limited, they had attached to them an unearned increment which ought to go into the pocket of the State.

So far as what has actually been proposed by the Glasgow Corporation is concerned, namely a comparatively small tax of two shillings in the pound on the annual assessed value of the ground, that would in the ordinary case be quite futile. It would simply mean that the rents would be adjusted accordingly and the tenant would have to pay. The question of imposing it as a charge upon the holder of the feuduties and ground annuals may be shortly dismissed. These are in some cases merely a form by which the price of the ground is converted into a perpetual annual payment. In other cases, and probably in the majority, they have no relation whatever to the price of the ground, but are simply a convenient method by which money is raised for the purpose of building, by the builder constituting a perpetual annuity on his ground. These annuities pass from hand to hand and are sold in the market just like railway or municipal debenture stocks, and it would be manifestly unjust to place a special tax upon this particular form of investment. It would, moreover, as regards the future, be highly impolitic as forming an obstacle towards the increase of buildings, by making it more difficult for the speculative builder to finance his operations.

But if it be granted that the profit made by the holding of urban ground is a fit object for taxation, the question arises how is this profit to be got at? It is obviously the person who has received it who ought to pay. If the Municipality had at the first foundation of the town either kept all the land in its own possession or secured

legislation by which the future increment in value would go to the community, there would have been no cause of complaint. A buyer of a building lot would know that he would have to pay a progressive tax as the community grew, and that whatever increment in value there might be would not benefit him. But the actual conditions of land tenure in our cities has been otherwise. Building land has been treated as a market commodity. The increment in value, if such has taken place, has gone into the pockets of successive owners, and the price that the present owner has paid when purchasing includes most of it. If there has been injustice in this system, the present owner has been the chief victim, as it is his pocket from which the price of the unearned increment has been taken.

It would be conceivably possible to call for a return of every transfer of property, and if the price received after deducting the price originally paid with interest showed a profit, to levy a tax amounting to either the whole or a portion of that profit. Such a tax would be a sort of income tax levied on a special kind of profit. But it is not probable that it would produce any great sum. It must be remembered that the holding of land costs something. A building lot worth £1000 a hundred years ago would require to be worth something like £50,000 to-day to give the original investor his money back with 4 per cent. interest. Had the Municipality held the lot all the time this would have represented their loss, apart from all other disadvantages which such a policy would have entailed. To go back to our American illustration of the founding of a new city, why is it that those who have the power at the commencement do not adopt the policy of holding all the land in their own hands and merely leasing it out? The reasons are—(First) That such holdings would not be really profitable as compared with selling out at once. The cash price that could at once be realized is worth more to the city than the sum they might reasonably expect to get by waiting fifty or a hundred years, and assuming that it is spent in assisting railway construction as it usually is, would be of far greater benefit to the community than the prospective value of fifty years afterwards; (Second) The success of any new town is uncertain. The cash down is a certainty and the purchasers of lots take the risk; and (Third) Private ownership stimulates the energies of the citizen, and is a main element in the success of any community. In fact what is

called unearned increment is in great part the result of the energy and enterprise of the individual owners of the town site. They have all along held the stakes. Their property being local and fixed is absolutely dependent for its increase in value upon the growth of the town and the success of its business. Others whose capital is floating, or who have only their labour to sell, may come and go. But the property owner is fixed. His fortune is bound up with the success of the town.

We might profitably pursue this line of thought even beyond our immediate subject. There is at the present time a tendency to forget what the real source of wealth is, or rather to place undue emphasis upon the secondary and more inert elements in its production. It is not the raw material of the earth, the forces of nature, the brute force of muscle, or even the mechanical dexterity which skilled workmen acquire by the constant practice of the same operation, which is the real productive power. These of themselves can effect little. The brain power which can show how they can be best utilised, discriminate the useless from the useful and develop the natural capabilities both of the land and of the workmen along the best lines, is the main factor in wealth production, and the selection and acquisition of the best sphere for productive work is within its sphere. There is of course an element of chance in all human affairs. The casual wanderer over a desert region may hit upon a gold mine where the systematic prospector may fail, but on the average and in the long run intellectual—and, it may be added, moral—force is the dominant factor. This might easily be illustrated by comparisons between different nations and different cities both in ancient and modern times, where the so-called unearned increment of land values in the one case, as compared with the other, can be shown to be the result of the brains of a few, rather than the toil of the many.

On some Types of Overfolding in the Schists of the Loch Tay District. By PETER MACNAIR, F.R.S.E., F.G.S.

[Read before the Society, 10th February, 1909.]

IN my former papers contributed to this Society, I have dealt in some detail with the great axial lines of folding which occur in the schists of the Southern Highlands of Scotland. In these papers I have attempted to show that the schists of that region have been plicated into a series of anticlinoria and synclinoria, and that in general the overfolding of the schists has been directed outwards from the axes of the anticlinoria. Towards the centre of these anticlinoria and synclinoria the folding becomes more or less symmetrical, the axis of each fold standing in a vertical position. As we proceed outwards from the anticlinoria the axes of the folds are seen to gradually dip towards the great axial lines of folding, passing from a vertical to an almost horizontal position.

The object of this short communication is to direct attention to some of the types of overfolding seen in the schists of the Loch Tay district, and more particularly to describe a specimen of the Ben Lawers phyllite in which the minor harmonic folding of that rock has been developed in extreme perfection, and which shows in a single block quite a variety of types of overfolding.

Few of the schists zones in the Loch Tay district exhibit in a more striking manner the effects of folding than the Ben Lawers phyllite series. The rocks of this zone consist to a considerable extent of greenish-grey soft phyllitic mica schists, with which are associated bands of quartzite varying in thickness from mere streaks up to beds of several feet.

The geographical extent and geological position of this schist zone have already been described in some detail in my former papers, and to these the reader is referred. It may, however, be as well to recall the fact that in the Loch Tay district this schist zone stretches from Meall Chuirn on the dividing ridge between Glen Dochert and Glen Lochay north-eastward by Craig Mhòr, Creag na Caillich, Meall nan Tarmachan and Ben Lawers to Fernan on the shores of Loch Tay. The average width of the

band is about three miles, and it forms the summits of the mountains just mentioned.

The great axial line of folding passes down the centre of this band of phyllite. Towards the centre of the band the folding is vertical and symmetrical, on the north-west margin the folds are unsymmetrical, usually presenting a long upper limb and a short under limb with the axis of the fold inclined more or less steeply towards the south-east. On the south-east margin of the phyllitic band the folding presents exactly the same character as on the north-west margin, the only difference being that the axes of the fold slope in the opposite direction. Proceeding still further outward, past the region of the fan-shaped structure, the folding becomes more undulating and irregular.

Passing now to a description of the different types of folding shown in the block of phyllite before us, we may note in the first place that the specimen presents almost all the lithological characters that are to be seen in the typical field section of the Ben Lawers phyllite. The block measures 20-inches in length by 5-inches in width. The specimen consists of greenish-gray soft phyllitic mica schist, with which is associated bands of quartzite varying in thickness from mere streaks up to about a quarter of an inch in thickness. As in almost every section where there is an intermixture of phyllite and quartzite, the rock shows evidence of having been subjected to repeated folding. In many cases the folding would have entirely escaped notice had it not been for the occurrence of the bands of quartzite, as evidence of the original stratification planes of the rock are almost entirely wanting in the phyllite.

Unfortunately the specimen was not obtained *in situ*, it having been found by Mr Jas. W. Reoch near the Falls of Lochay, about two miles north-west of the village of Killin. It cannot, however, have come from any great distance, as the Ben Lawers phyllite zone crosses the glen between the Falls of Lochay and Duncroisk. Near the place where the specimen was found the exposures of the phyllites show the axes of the isoclinal folds dipping towards the north-west, and it seems highly probable that the specimen is from the south-west margin of the phyllite band.

In the upper part of the specimen (see Fig. I.) there can be distinctly traced three bands of quartzite separated by thin films of phyllite, the three bands have an aggregate thickness of about half

an inch in their unfolding parts. In a distance of twelve inches they have been subjected to four distinct plications of an isoclinal type. The effect of these folds has been to reduce the original extension of the bands by about one-half. The axes of the folds all had in the same direction, though at varying angles some of the folds are perfectly symmetrical, but as a rule there is a long upper limb and a short under limb. The depth of the folds relative to their width also vary to a considerable extent, some



FIG. I.—PART OF BLOCK OF PHYLLITE SHOWING DETAILS OF OVERFOLDING.

being quite shallow, while in other cases the length of the fold may exceed its width by more than thirty times.

One of the four folds into which the three bands of quartzite have been plicated presents a much more complex structure than the others, instead of consisting simply of a single arch the crest has been bent into three distinct flexures, as shown in Fig. I. As a consequence of this rapid folding, the apparent thickness of the layers of quartzite has been increased four times. A further notable feature in connection with the folding of these three bands is the fact that they can be traced continuously through the whole length and width of the specimen.

In the lower part of the specimen there occur a series of folds of a somewhat different type from those already described. The

band of quartzite involved in this set of flexures is about a quarter of an inch in thickness, and is separated in the centre by a thin film of phyllitic material. The existence of the film has enabled me to trace the band through the entire length of the specimen. The remarkable feature in the folding of this band is the extremely attenuated character of some of the folds. Reference has been made to one example in which the under limb of the fold has been bent back so sharply upon the upper limb that the two limbs appear to be almost parallel with each other for a distance of six inches. On the upper limb of this same fold, however, there can be seen

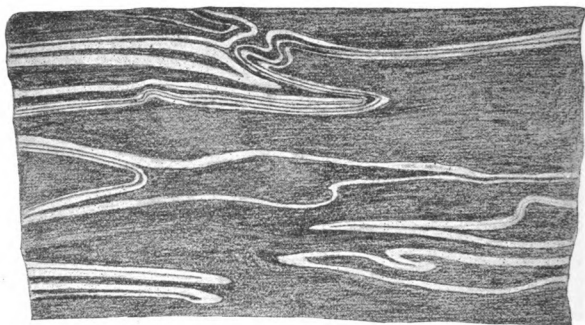


FIG. II.—PART OF BLOCK OF PHYLLITE SHOWING DETAILS OF OVERFOLDING.

a simple and almost symmetrical open anticlinal fold (see Fig. II.), thus demonstrating that two folds of a directly opposite type may be produced in close conjunction with each other. Another type of folding prominently exhibited by this band shows a straight upper and under limb of about six inches in length which for a space of an inch has been suddenly bent into an S shaped fold.

Another important feature in the folding of these schists, that is strikingly exemplified in the specimen, is the existence of a series of complex foldings at right angles to the general dip of the foliation. Folding of this type has been observed on a large scale in the Alps by Professor Bonney, who has pointed out that in addition to the long curving folds which determine the direction of the component ranges, they give indications of a cross folding.

Fig. III. *A* shows a band of quartzite folded in a most complex manner along the dip of the foliation planes, while *B* shows the cross folding taken along the section *ab*.

I now pass to a consideration of the bearing which the study of this specimen has upon the longer structural features of the district. It seems to me that a careful study of the various sections of the Ben Lawers phyllite exposed in the Loch Tay district tends to confirm the idea that the minor folding seen in the specimen just described reflects to a considerable extent the major folding of the schists in that region. In the various stream sections exposed on Craig Mhòr, lying on the ridge between Glen Dochert and Glen Lochay, quite a number of interesting exposures can be studied,

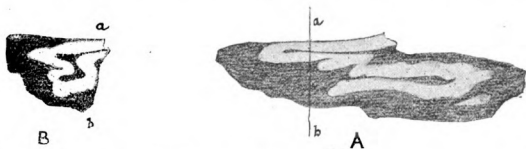


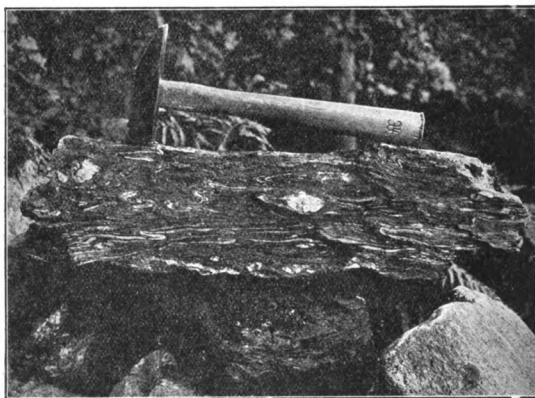
FIG. III.—(A) LONGITUDINAL SECTION OF A FOLD; (B) TRANSVERSE SECTION ACROSS THE LINE *ab* TO SHOW CROSS FOLDING.

and in these the folding shown on a large scale exhibits all the features seen in the block which has just been described.

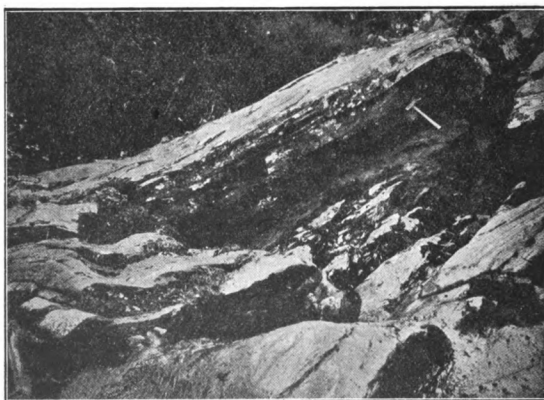
Fig. IV. shows a fold of quartzite in the Ben Lawers phyllite series exposed in the stream that rises on the western side of Craig Mhòr and joins the Lochay near Corrycharamaig. I have been able to trace the upper limb of this fold for nearly 20 feet, dipping at an angle of 45° to the south-east. The under limb is bent sharply backwards for a distance of two feet, but beyond this I have not been able to follow it. From a consideration of the structure of the ground this fold appears to have exactly the same character as many of those shown in the block of phyllite which has been described. In this stream section the manner in which the quartzites come to the surface leaves scarcely a doubt that they are but the truncated limbs of isoclinal folds of a similar type.

Some fine examples of overfolding can be seen in a section on the Callander and Oban Railway at the old Killin Station near the head of Glen Ogle. Here the Loch Tay limestone has been folded along with a sill of epidiorite, the latter occupying the core of the fold.

FIG. IV.



BLOCK OF BEN LAWERS PHYLLITE SHOWING OVERFOLDING.

ISOCLINALLY FOLDED QUARTZITE, GLEN LOCHAY,
PERTHSHIRE.

The axis of the fold dip gently towards the north-west. At this point the folding lies about three miles to the south-east of the great axial line. The major fold has an upper limb which is close upon thirty feet in length, and is almost horizontal. The under limb, of which only about 15 feet can be seen, dips to the north-west at an angle of 15° , and is soon lost below the formation level of the railway.

The minor folding which is beautifully developed in the limestone of this section can be seen to pass round the core of epidiorite in a series of isoclinal folds. Along its margin the sill of epidiorite exhibits a well marked schistose structure, but no distinct folding can be traced. Nevertheless it is quite clear, from a consideration of the overlying limestone, that at this point the epidiorite must be bent into a sharp fold, the crest of which is seen rising above the formation level of the railway. The bedding planes in the limestone can easily be detected by the intercalation of thin layers of calcareous mica-schist. The folds exhibit the same type as seen in the specimen of Ben Lawers phyllite, and show a long upper limb dipping towards the north-west at a low angle, and a short under limb dipping in the same direction at a steeper angle. Near the crest of the major isocline the minor folds are seen to assume the compound structure developed on a small scale in the block of phyllite.

All along the north-west side of Loch Tay, from Killin to Fernan, there occur numerous exposures of the Loch Tay limestone, and in these many fine examples of the overfolding of the schists may be observed. The limestone outcrops at a distance of about two miles from the great axial line of folding, and the characteristic overfolding towards the south-east can be seen in many of the exposures. A typical section has been described by me in the "Geology and Scenery of the Grampians,"¹ it occurs on the roadside at Drumnalarig, about a mile and a half to the north-east of Killin. The existence of what appear to be cores round which the limestone has been folded can often be observed in the Loch Tay district.

In conclusion, brief reference may be made to the probable manner in which these different types of overfolding have been developed. It has usually been assumed that the overfolding in

¹ Vol. I., p. 113 and p. 163.

such complex areas has been directed outwards from the great axial lines of the anticlinoria, and that the axes of the folds had towards these. Recently Mr George Hickling¹ has advanced the theory that the axes of the folds dip towards the great axial lines of the synclinoria. He has arrived at this conclusion from experiments carried out in the folding of thin sheets of paper upon which vertical lines have been drawn to represent the axes of the isoclinal folds. When the paper has been forced into folds it will be found, he says, that the vertical lines no longer occupy their vertical position, but they all dip towards the axis of the major syncline on each side. I cannot, however, agree with Mr Hickling on this point, as I find that any experiments that I have made with the compression of layers of clay confirms the principle that the limbs of the isoclinal folds dip towards the axes of the anticlinoria, and not the synclinoria as maintained by him.

If we could only suppose that the complex folding shown in the block of Ben Lawers phyllite is also typical of the major folding of this region, and that the different schist zones have been folded according to the same principle, we can easily imagine how exceedingly intricate the detailed structure of the Grampians must be. At the same time I think that the careful study of such characteristic examples of the minor folding, as we have shown in this block of phyllite, might help to throw light upon some of the larger structural features of this region.

¹ Geological Magazine, Decade V., Vol. IV., p. 506.

The Laws of Individual Growth.
By ARNOLD H. GRAY, M.B., Ch.B.

[Read before the Society, 7th April, 1909.]

THE subject of this paper, the Growth of the Individual, requires a little explanation.

Although a great deal of work has been done on the growth of children, and numerous observers have published their results, still, with very few exceptions, all these records were obtained by taking the average heights and weights of children at the various ages between infancy and maturity.

The published tables therefore shew very conclusively the changes which take place in the rate of growth during the various years of childhood and adolescence, but as they are made up from isolated observations on large numbers of different children, they leave a great want of information about the laws which regulate the growth of the individual.

In order to investigate these laws it was necessary to have a separate series of observations, taken at more or less regular and frequent intervals, of the height and weight of each individual. Such records were obtained from the Anthropometric Register of Bootham School, York.

At that School a note is made of the height, weight and physical condition of every boy at the beginning and end of each term, *i.e.*, six times per year; and as physical exercise of all kinds enters largely into the curriculum, the boys are continuously in hard condition, and the sick-rate practically nil, the records can be accepted as those of normal, healthy individuals.

Then to elucidate certain phenomena which appear in the growth of the human being, a number of experiments on the growth of animals and plants were performed.

Records of the growth of 250 boys were taken from the Register, the height and weight curves plotted out on a separate chart for each individual, and in order that the results might be as far as possible representative of the incidence of the various forms of

growth and the relative frequency with which they occur, the records were consecutive, taken in the order in which they appeared in the Register, that is in the order of the boys' entrance to the School. Some only cover periods of eighteen months, but the large majority extend over a matter of four years, while a few are seven or even eight years in length.

The ages of the boys under observation ranged between ten and nineteen years.

Considerable difficulty was experienced in reducing the 250 charts to any sort of arrangement according to the type of growth displayed. While hardly two of them were alike, certain others presented such diverse and definite characteristics as to suggest of themselves a method of classification.

Charts shewing Regular Growth, with continuous and steady increase sustained over the whole period of observation, form the First Group, while at the other extreme the Third Group is made up of typical examples of Cyclic Growth. By the term "cyclic" is meant a succession of variations in the rate of growth which occur in a definite order and with perfect regularity, so that, when one cycle is completed, it is followed by a second presenting precisely the same features as the first, and which, in its turn, is succeeded by a third, and so on.

Between these two groups, the Regular and the Cyclic, comes a large series comprising the great proportion of the charts, in which the rate of growth is Irregular, shewing periods of indefinite length when increase is either accelerated, retarded, or perhaps completely arrested.

Of course this classification is purely arbitrary, and as one group merges almost imperceptibly into another, there are necessarily outlying charts which come just on the borderland and which required repeated rearrangement before their positions were finally determined. It is now proposed to describe briefly the main features of these three groups.

With reference to the First Group, composed of charts shewing the Regular type of growth, little need be said. It may be well, however, to mention that as the average length of a chart in this group represents over three and a half years, and that from commencement to close each one gives evidence of a uniform rate of increase, the continuous or regular nature of the mode of growth is beyond question.

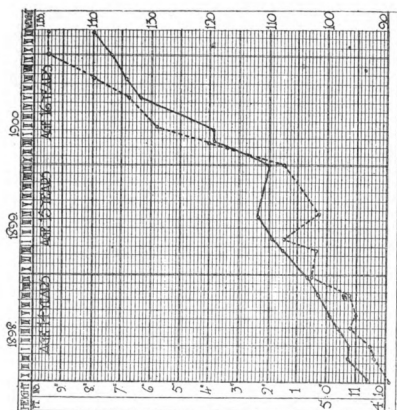


FIG. II. Irregular type of growth. Group II: Class B:

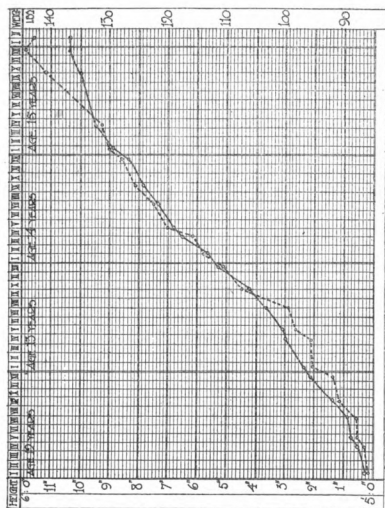


FIG. I. Regular type of growth. Group I:

The group is a small one, comprising as it does only 12·3 per cent. of the charts. Every one presents the same feature, an unbroken line of ascent, the growth of one year being almost identically repeated in the next, and apparently quite uninfluenced by seasonal change or other external agency.

Fig. I. is a typical example from the First Group, and it will be observed that a uniform rate of increase was maintained throughout the four years during which this boy was under observation.

As less than 13 per cent. of the 250 charts shew growth of the Regular type, it is evident that, although unquestionably occurring in some cases, it is not the common mode of growth in Man.

On observation of the growth of rabbits and guinea pigs the Regular type was found, though of somewhat rare occurrence there also; while in the growth of the internodes of plants, uniformity and regularity in the rate of increase was the marked feature of the curves of growth. Plant internodes furnish examples of the Regular type of growth in its purest form. The curve of internodal growth might be described as having a primary phase of extreme but shortlived energy, during which, increase is continuous and very rapid. When the first outburst of growth is spent, there is, as a rule, no further addition to the length of the internode. The cells start with a certain amount of reproductive energy, and until this is exhausted the growth of the internode is steady and uninterrupted. Internodal growth may therefore be taken as representative of the Regular type, for while growth lasts, from commencement to close, the rate of increase is uniform and continuous.

With regard to the Second Group of charts of the growth of boys, Irregularity in the rate of increase is the essential characteristic. The series is large, and contains nearly 83 per cent. of the total charts. As a rule the variations in the rate of growth are slight, and merely amount to alternating periods of indefinite length when increase is either more rapid or slower as the case may be. There are, however, all grades of irregularity, from the faintest undulation in the ascending line of increase to charts shewing periods of extremely rapid growth and periods of weeks or perhaps months duration, in which growth is completely arrested, when no increase whatever takes place. Thus the series is to be considered as starting with charts of almost regular growth, followed by others becoming gradually more and more irregular, and accord-

ing to the degree of irregularity the group has been divided into two classes, A and B, the charts in Class A shewing a comparatively small amount of variation, while Class B is limited to those in which the curve of growth is extremely irregular.

Class A is much the larger, containing fully 87 per cent. of the charts in Group II. In the earliest charts in this class the rate of growth, taken as a whole, is fairly uniform, but irregularities are also evident. In the later charts the rate of growth is markedly variable. The curve is composed of successive periods of unequal length when increase is either rapid, slow, or in entire abeyance. There are periods of accelerated and retarded growth, but these periods are irregular in the time and frequency of their recurrence, and do not conform to any cyclic arrangement as will be found to be the case with the variations in the Third Group. Essentially all the charts present the same feature, irregularity, the only point in which they differ from one another being in the degree of variation displayed, and as Class A is limited to those which shew only a slight amount of irregularity, the differences between the individual charts are small.

In Class B of the Second Group are only a few charts, but each one presents great irregularity in the curve of growth, and their features are sufficiently distinctive to warrant their being classed by themselves.

The chart shewn in Fig. II. belongs to Class B, and has been selected as an example of the most pronounced form of the irregular type of growth. During the first eighteen months, from October, 1897, to April, 1899, an even line of uniformly regular growth is presented. Following this, however, is a period of arrest lasting for six months, till the end of September, and in which a decrease of three-eighths of an inch is recorded. On the return of active growth in October increase is extremely rapid, and in the succeeding seven months an addition of four and three-eighths inches is made. From May, 1900, until the close of the observations in December, increase is slower and comparatively uniform in rate.

It may be well to note here, in reference to these periods in which there is decrease in height, that probably this phase of retrogression does actually occur. It can hardly be accounted for by inaccuracy in observation, as it has long been recognised and remarked by the Bootham School authorities, and in some of the

charts a gradual descent can be traced through a succession of consecutive observations.

Loss in height is shewn in several charts in Class B of Group II. and also in some of the cyclic ones in Group III., so that it would appear to be of fairly frequent occurrence. In most instances it takes place after an outburst of very rapid growth, but this is not invariably the case. Diminution in the length of fish has been noted by Dr Fulton¹ as occurring when growth is arrested during the winter months.

An analogous decrease was frequently observed following the cessation of growth in the internodes of plants, and in the observations of the growth of rabbits and guinea pigs periods of arrest accompanied by loss in weight were common.

The explanation of decrease in stature in Man is not clear. Presumably it is due to loss in bulk of the fibrous intervertebral discs. As the measurements were always taken at the same period of the day—the forenoon—it can not be explained by daily variation. Whether it is to be accounted for by withdrawal of moisture or whether there is absorption of fat from the tissues under the heel and from the nucleus pulposus of each intervertebral disc is not clear, but, as quite commonly the weight is rising while the decrease in height is taking place, the latter explanation seems hardly probable. A third suggestion is that perhaps during active growth the proliferating cells in the discs are of the large embryonal form, and contracting on becoming mature, produce a minute shrinkage of the disc as a whole. This idea is strengthened to some extent by the comparatively frequent occurrence in this series of observations of gradual and prolonged decrease in stature of boys between the ages of sixteen and eighteen, and in whom the stage of active growth is almost spent.

The most noteworthy feature of the irregular charts belonging to the Second Group is the occurrence of these periods of rest in the curves of growth—periods in which increase may be only retarded or may cease altogether, while occasionally actual loss in height is recorded.

The irregular type of growth is the one by far the most frequently found in Man, and in the observations of the growth of rabbits

¹ Fulton. XI. Annual Report of the Fishery Board for Scotland. Part III., p. 192.

there were numerous examples of a pronounced form of this type.

The Third and last Group contains the charts shewing the Cyclic type of growth, representatives of a form common among many of the lower animals, but as it is a small group, comprising only 4·7 per cent. of the total cases, it is evident that the cyclic variety is a comparatively rare form in Man.

The curve of growth is made up of a series of subsidiary curves formed by the changes in the rate of increase and marking off the separate cycles, any one of which would almost exactly coincide with either of its neighbours so regular are they in time and degree of variation displayed.

The time occupied by a single cycle varies in the different charts, and in the group there are examples of cycles occupying four, six, eight, ten and twelve months, while in one chart the swing is even longer, extending over fifteen months.

The chart shewn in Fig. III. is a specimen of Group III., and in it the cycle occupies a period of twelve months. It has been chosen as it is one of the longest charts in the group, although in it there is no very wide range in the rate of growth, and therefore the curves representing the cycles are less prominent than in many of the others. The cycles begins with a period of complete arrest lasting for fully two months—February and March—and frequently, as in the years 1899, 1900 and 1901, there is decrease in height at this time. In April active growth returns, and increase is well sustained over the spring and summer months, with gradual slowing towards October, November and December, which again is invariably followed by a short burst of rapid growth in January.

This is one of three charts in which periods of twelve months are occupied by the cycles, and, showing the same phenomena occurring year after year, raise the question of seasonal influence on growth, a point which will be dealt with later. The same of course does not apply to the other charts in the group, in which the cyclic changes take place every four, six, eight, ten and fifteen months.

Perfect examples of this cyclic type are found in the growth-curves of many of the lower animals. In, for instance, an exoskeletal animal such as the crab, growth is essentially cyclic, a more or less regular alternation of outbursts of rapid growth and periods of arrest. In the crab growth takes place during a moult,

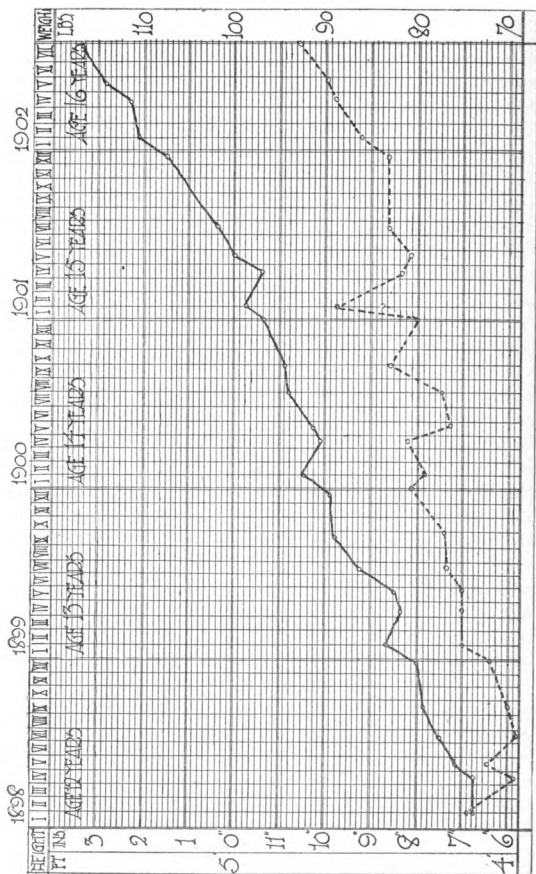


FIG. III. Cyclic type of Growth. : Group III :

when the whole test is thrown off, and while the new shell is still soft increase in size and weight is rapid. During a moult there are sudden and rapid additions both to the size and weight, and these continue to a minor degree for a short time afterwards until sufficient quantities of lime-salts have been deposited in the shell to at least limit if not cause total cessation of growth.

In the intervals between the moults, once the new shell has become hard, it is probable that there is no increase in size. A slight increase in weight, on the other hand, does take place throughout the whole period. With the occurrence of this gradual gain in weight without increase in size, the question arose as to whether it was due to actual cellular proliferation or if it might be accounted for by mere accretion of lime in the shell. To settle this point, the cast shells were calcined and the amount of lime found in each estimated and compared with the increase in weight which had occurred during the respective inter-moult periods. In most instances the increase in weight which had taken place in the periods between the moults accorded precisely with the weight of the calcareous material which had been deposited in the shell, so that the actual weight of the crab's body, irrespective of the shell, was constant from the termination of one moult to the commencement of the next.

Growth therefore takes place during a moult, and then only, and the interval between the moults is more a time of rearrangement and recuperation than of cellular activity—cyclic growth in its most perfect form.

It is unnecessary to do more than mention the evidence of growth in Man as furnished by the curves of weight. The measurement of height is the more accurate index of growth; the different types as shewn by the height records have been described, and no new points emerge on studying the progress of growth from the point of view of the weight.

As a rule there is a fairly close accordance between the rates of increase in height and weight, but this is not always so, for occasionally rapid increase in weight is observed while the height remains stationary, or, more rarely, the converse, the weight records shewing no increase while rapid additions are in progress. Usually, however, the features of the curves of weight and height are remarkably similar in the individual charts.

Having outlined the three groups, Regular, Irregular, and

Cyclic, into which the growth charts of healthy boys were divided, three points remain for consideration. The first of these has reference to the rate of growth during the periods of active increase in the Irregular and Cyclic types.

On looking over the charts belonging to Groups II. and III., the rates of increase in the phases of activity are extremely variable. The most rapid growth observed was one inch per month, which occurred in three instances; seven-eighths and three-quarters of an inch per month were comparatively frequent, while an increase of one-half to five-eighths of an inch in the month were common. The duration of the periods of activity varies also. As a rule it was between three and six months, but occasionally lasted only one month, while examples shewing active growth over a period of nine months or even a year were not infrequent.

The second point concerns the growth of children suffering from acute diseases. Growth during prolonged illnesses and their convalescence, and more especially the acute fevers, has received a considerable amount of attention from various authors.

Many papers have been published, such as the Thèse de Paris, 1881, in which Auboyer collected from the medical literature of the time a number of facts regarding exaggerated growth following acute illnesses; or M. Bouchard's paper read before the Soc. Clinique de Paris, 1879, in which he discusses the rapid increase in stature which occasionally takes place during typhoid fever; and Comby, in a chapter on growth in *Traité des Maladies de l'Enfance*, states that he has frequently observed an increase of ten, fifteen or twenty centimetres after illnesses which have necessitated confinement to bed for a few weeks or months.

On looking over the literature it would seem as if only those cases had been recorded in which exceptional growth followed an illness. There is no mention of any systematic measurements having been made before and after an illness, and as only the instances of extremely rapid growth are cited, an exaggerated idea of the frequency of its occurrence is conveyed.

At Belvidere Fever Hospital, for a period of eighteen months, almost every child under ten years of age was weighed and measured at the time of its admission to hospital and again on dismissal.

On account of the nature of the disease, the records of Enteric Fever, which, according to the French authors, is one of the

illnesses most frequently accompanied by rapid growth, are too few to be of any value, so they are not included.

Records have been obtained, however, of 1395 cases of Scarlet Fever, Measles, Whooping Cough and Diphtheria. For the present objects only the heights need be considered, as unquestionably a child's nutrition suffers during the stage of incubation, and therefore a large increase in the weight between the times of admission and dismissal could not be taken as an index of the activity of growth during the course of the disease and its subsequent convalescence.

In working out the average annual rate of growth of children suffering from the four acute fevers under notice, all the records referring to infants under two years of age have been neglected. Normally the increase in stature during the first two years of extrauterine life is twice as rapid as that between the ages of two and ten. The number of children under two years included in this inquiry is too small, in comparison with the relatively large number of higher age, to allow of the average rate of growth being taken over the whole series.

Considering then, only children between the ages of two and ten years, it is found that in Scarlet Fever the average duration of a child's residence in hospital is 8.04 weeks, an average growth of .349 of an inch, giving an increase of 2.25 inches in the year. In the same way with Measles, the average residence works out at 3.74 weeks, with an increase of .15 of an inch, or a mean annual growth of 2.08 inches. The Diphtheria averages find a growth of .37 of an inch in 9.42 weeks, a yearly increase of 2.04 inches; while in Whooping Cough an average increase of .52 of an inch in 8.38 weeks gives a yearly addition of 3.22 inches.

Comparing these average annual growths during fevers, 2.25 inches in Scarlet, 2.08 inches in Measles, 2.04 inches in Diphtheria and 3.22 inches in Whooping Cough, with the normal mean yearly increase between the ages of two and ten the result is striking. The average annual increase in normal, healthy children between these ages, from the statistics published by Cruchet¹ is 2.5 inches, from Roberts' figures 2.57 inches,² and from those of Comby 2.66

¹ Cruchet. *La Pratique des Maladies des Enfants*. Vol. I., Chap. "Croissance."

² Roberts. Quoted in *Cyclopædia of the Diseases of Children*. Vol. IV., Pt. I., p. 283.

inches.¹ It will be observed that, instead of being more rapid, the average rate of growth during Scarlet Fever, Measles and Diphtheria is slower than in health, and that Whooping Cough with its 3·22 inches is the only one of the diseases under notice in which the rate of increase is accelerated.

The reason for the average rate of growth in Whooping Cough being so much higher than in the other three fevers is not evident. As a class, the children admitted to hospital suffering from Whooping Cough were drawn from a lower social grade than was the rule in the other infectious diseases, and it is possible that they shewed a greater reaction to the improved hygienic conditions of hospital life. Another explanation may be that the bony epiphyses are stimulated by a raised blood tension due to back-pressure from the increased resistance in the pulmonary circulation. This idea was to some extent borne out by testing the blood pressure with the sphygmomanometer, when it was found that in Whooping Cough the average pressure was higher throughout than the normal average, and that during, and for a short time after, a paroxysm of coughing the pressure was considerably in advance of this. (Unpublished results by Macdonald.)

Considering the growth of the individual rather than the average growth, one finds that 65 children out of the total 1395 under observation, or 4·6 per cent., shewed extremely rapid increase in stature during their time in hospital.

In the 462 cases of Scarlet Fever, rapid growth occurred in 23; the most marked instance being that of a girl of six growing 4½ inches in eight weeks; in fact this is the most rapid increase recorded in the whole series of observations. The total number of Measles cases measured was 465, and in this disease also there were 23 instances, while out of the 88 cases of Diphtheria only 3 shewed any very rapid growth. Although the average rate of increase is so much higher in Whooping Cough than in Scarlet Fever, Measles or Diphtheria, only 16 of the 380 children measured during that disease shewed great activity of growth.

It is difficult to compare the incidence of spurts of rapid growth in health and in disease. Sudden outbursts of rapid increase have been shewn as occurring in normal health without any apparent

¹ Comby. *Traité des Maladies de L'Enfance*. Vol. I., Chap. "Physiologie et Hygiène de l'Enfance."

cause, but it would seem as if one of these spurts might be precipitated by an attack of illness.

If one may compare growth during the second decade with that of the first, and setting the standard of "rapid growth" at a minimum of one-half inch per month, in the observations of healthy boys already detailed it is found that in the total of almost one thousand years of growth investigated there are five hundred and fourteen instances of rapid increase, whereas, in the inquiry into growth during an acute illness, it occurs two hundred and thirty-five times in a matter of one hundred and fifty-eight years—in other words, rapid increase occurs almost three times more frequently during the course of an acute illness than it does in health.

The figures for these observations are somewhat limited, however, and comparison of the growth of children between the ages of two and ten with that of boys between ten and twenty is perhaps hardly justifiable.

The above ratio of 3 to 1 is further modified by the fact that the children measured before and after the fevers were, during their residence in hospital, living under immensely improved hygienic conditions. The salutary effect of healthful surroundings and an adequate and wholesome dietary upon the growth of children is well known. It is thus almost impossible to estimate the influence of an attack of fever, *per se*, in bringing about a spurt of rapid growth, and probably the ratio of 3 to 1 is considerably higher than is really the case. Whether this is so or not, it is a significant fact that the average rate of growth during the three fevers, Scarlet, Measles and Diphtheria, is slower than in health.

The third and last point refers to the possible effects of temperature and environment in influencing the types of growth, but before discussing the relations of temperature to growth in Man, the results of some experiments performed on lower animals should be noted.

Professor Minot, of the Harvard Medical School, has demonstrated the very close connection that exists between the temperature of the surroundings and the rate of growth of young tadpoles¹; and Dr Fulton's observations and experiments on the rate of growth of fishes² shew the same thing, that the rate of increase is

¹ Minot. The Problem of Age, Growth and Death. P. 88.

² Fulton. XXII. Annual Report of the Fishery Board for Scotland. Part III. "The influence of Temperature on the growth of fishes."

directly related to the temperature of the water, though not so intimately as in the case of the tadpoles.

The relation of temperature to growth in Man is more difficult of investigation than in the lower orders, as the types of growth in the human subject are various and complex. An attempt has been made, however, by charting the incidence of periods of rapid growth and periods of arrest in the several months of the year and comparing these with the mean temperature curve. Such charts are found in Figs. IV. and V.

The dotted line represents the averages of the mean temperature for each month taken at York over a period of forty years.¹ In Fig. IV. it will be noted that there is considerable discrepancy between the times of greatest frequency of active growth and the times of high registers on the thermometer. The maximum temperature is reached in July, while May is the month in which rapid growth was most commonly recorded, and further, in December, one of the coldest months, with a mean temperature of $39^{\circ}\text{F}.$, active growth was more often observed than in August with its mean temperature of $59^{\circ}\text{F}.$ Thus the incidence of spurts of rapid growth, apart from being highest in the months between April and July, accords but little with the temperature curve.

Fig. V. combines the incidence of periods of arrest with the temperature curve, and is more suggestive of some connection between temperature and growth. As a general rule the colder the month the more frequently did periods of arrest occur—but it must also be noted that the incidence of these periods of arrest is only roughly in inverse proportion to the temperature. For example, the thermometer stands at practically the same point in March and November, and yet retarded growth was considerably more common in the former month than in the latter.

It is evident from Figs. IV. and V. that either great activity or complete cessation of growth may occur in any month of the year, and therefore low and high temperatures by no means prohibit rapidity or retardation of increase, although perhaps the higher temperatures predispose to activity of growth and *vice versa*. The Regular charts in Group I. and the Cyclic ones of Group III. are certainly quite independent of changes of temperature, so that at

¹ Buchan. Journal of the Scot. Meteorolog. Soc., 1898. "The Mean Atmospheric Pressure and Temperature of the British Islands."

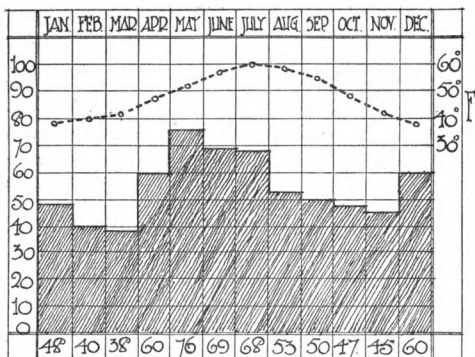


FIG. IV. Shewing the relation of the mean Temperature Curve to periods of rapid growth.

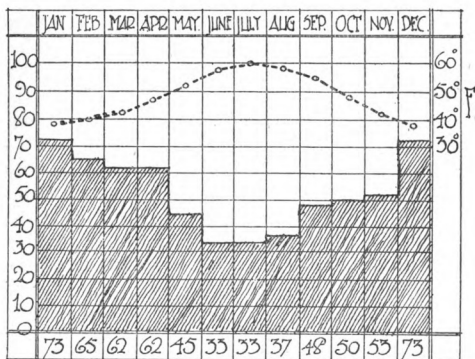


FIG. V. Shewing the relative of the Mean Temperature Curve to periods of arrested growth.

least the types are unaffected, whether growth as a whole is, or is not, stimulated or retarded by warmth and cold respectively.

In Man the mass of evidence indicates that the rate of increase is uninfluenced by temperature, which is probably to be explained by the fact that Man is a warm-blooded animal, and therefore external temperatures do not interfere with the metabolic processes.

With regard to environment and growth, it is not proposed to discuss the effects of physical surroundings on growth in general, but merely to consider whether they have any bearing on the various types of growth which are displayed by children.

The influence of nutrition on growth has been proved, the rate of increase varying directly with the sufficiency or insufficiency of the food supply,¹ also that the conditions of housing, another factor almost inseparable from nutrition, play a very important part in the growth of the child.²

Although it has been proved beyond question that the different conditions of the social grades favour or impede growth, it is no argument that they have any influence on the type of growth which the child will present.

Unfortunately the series of records of the growth of boys obtained from Bootham School gives little scope for observing the possible effects of altered surroundings. The only opportunities offered are at the times of holidays, and though these brought about a multitude of small changes in locality, habit, &c., the hygienic conditions of school and home life were equally favourable, so that any very apparent interference with the types of growth could hardly be expected to result from them.

April, August and September, and December and January were the months in which holidays took place. In the Regular and Cyclic charts of Groups I. and III., the types are apparently quite independent of external conditions, so it is only in the Irregular charts of Group II. that evidence of the influence of surroundings may be looked for.

Figs. IV. and V. shew that the incidence of rapidity or arrest of growth during the Easter holidays in April, or the Summer ones in August and September, is not out of proportion to that for the

¹ Medical Inspection of School Children, p. 206.

² Report by Dr W. Leslie Mackenzie and Capt. A. Foster on a collection of statistics as to the physical condition of children attending the Public Schools of the School Board for Glasgow.

months immediately preceeding and following them. In December and January there is a rise in the frequency of rapid growth in comparison with November and February, but as it is also in December and January that arrested growth is most commonly recorded, the occurrence of the Christmas holidays can not be said to have had any more effect than the Easter and Summer ones on the growth shewn by these charts of the Irregular type.

Such evidence, as is available points to the types of growth being independent of, and unaffected by, the conditions of the surroundings, in spite of the fact that environment plays such an important part in increasing or diminishing the rate of increase and possibly the ultimate limit of growth.

It would seem as if all growth might be classified under the three headings, Regular, Irregular, and Cyclic, and whilst, in various organisms, growth is confined to one type, as for example, the cyclic form in animals with an exoskeleton such as the crab, or the regular form in the growth of a plant internode, in others, for instance Man, examples representing all three types are found. It is suggested that the mode of growth pursued is due to some inherent property of the individual, and that environment and all other external influences play little, if any, part in determining the type of growth.

It is significant that in the series of 250 charts of the growth of healthy boys, and in which the three different types were represented, there were nineteen instances of two or more members of the same family having been under observation. In this total of forty-three charts, four in Group I., thirty-nine in Group II., the growth of brothers was remarkably similar, pointing to the child being born with a tendency, possibly hereditary, towards one form of growth or another, and against the casual influence of extrinsic agencies producing Regularity, Irregularity or Cyclic variations in the rate of growth.

Physique of Glasgow Children: An Inquiry into the physical condition of Children admitted to the City of Glasgow Fever Hospital, Belvidere, during the years 1907-1908. By ALEXANDER S. M. MACGREGOR, M.D., Junior Assistant Medical Officer of Health, Glasgow; late Assistant Physician, Belvidere Fever Hospital, Glasgow.

[Read before the Society, 21st April, 1909.]

THE earliest scientific inquiry into the physique of school children in Scotland is contained in the Report of the Royal Commission on Physical Training (Scotland) published in 1903. For the purposes of that Report, Dr Leslie Mackenzie and Professor Matthew Hay organised an inspection of some of the school children of Edinburgh and Aberdeen. Other investigations on a limited scale were conducted under the auspices of the Edinburgh Charity Organisation Society, and of the Dundee Social Union. Their results were published in 1906 and 1905 respectively. For Glasgow, two authorities are available. Prior to the issue of the Report on Physical Training, Dr A. K. Chalmers had instituted an inquiry on similar lines into the physical condition of the children attending Glasgow Schools, selected with a view to correlating the physique of the children with the economic condition of the districts in which the schools were situated (1904). Following this, in 1905, a comprehensive investigation was carried out by the teachers of the Glasgow School Board in 73 primary and higher grade schools throughout the city. The statistics of heights and weights so collected formed the basis of a Government Report by Dr Leslie Mackenzie and Captain Foster issued in 1907. Particulars as to the size of the house were also obtained and the figures tabulated, in order to illustrate the general relationship of physique to environment. These reports will be referred to later.

For the present inquiry, which was conducted throughout under the guidance of Dr Brownlee, Belvidere, records of measurements were obtained from over 1700 children admitted to the wards of Belvidere Fever Hospital during the years 1907-1908, the details

of social condition, etc., being obtained from data collected by the Glasgow Health Office. The analysis of these data was begun and considerably advanced by Dr J. R. Currie, whose recent appointment as Assistant Medical Officer of Health for Chester caused him to relinquish the work. The objects in view were :—

- (a) To obtain records of the heights and weights of children under school age, and so include a group not so far reached by statistics.
- (b) To inquire into the child's capacity for improvement. In this way some measurement could be obtained of the recuperative power of the children when withdrawn from noxious surroundings and placed under the hygienic conditions of a hospital ward. Much significance was expected to attach to this part of the inquiry, as much of the material studied was drawn from the most unpromising surroundings.
- (c) To obtain statistics bearing on the physique of the rachitic child and its relation to housing conditions.
- (d) To obtain information as to the physique of infants in relation to their susceptibility to infectious disease.

Each child under 10 years of age, where its condition permitted, was weighed on admission and on dismissal without clothing, and its height measured. The records extended over two years. It was considered sufficient for the purposes in view to select children admitted to the Scarlet Fever, Measles and Whooping Cough wards, those admitted under the latter category being almost entirely from the very poorest districts. As about 90 per cent. of the total cases of Scarlet Fever are admitted to hospital, there is *a priori* a presumption that these will afford a fair sample of the city child, a presumption which will be seen later to be justified. Of the total children admitted with Whooping Cough, 93·4 per cent. came in almost equal numbers from houses of one and two apartments. In the case of Measles, 95·5 per cent. were similarly derived, although this number contains a somewhat higher percentage (9 per cent.) of children from the two-apartment house. In the Scarlet Fever group of children, on the other hand, only 76 per cent. were derived from one and two apartment houses. Of the male and female children of school age on which Dr Mackenzie's figures are based, 66 per cent. and 65·6 per cent. respectively are derived from one and two apartment houses. Although Dr Mackenzie's analysis includes a rather higher percentage of children from houses of three and four apartments, yet this comparison shows that the Scarlet Fever children are derived

in much the same proportion from the various classes as are those on which Dr Mackenzie's standard is based.

Having outlined the purposes of this paper, the figures obtained will now be considered in detail.

In the Tables I. and II. the mean heights and weights of the Scarlet Fever children at the different ages are given, and compared with Dr Mackenzie's means for children of school age. In the case of the males, the heights of the

TABLE I.—*Total Heights.—Ages 2-10, compared with Standards.*

Age.	Sex.	Scarlet Fever.		Glasgow Standard Mean Heights (Mac-kenzie).	Glasgow Standard Mean Heights (Kay).	Anthrop. Comm. Standard Means.	Measles.		Whooping Cough.	
		No. exam-ined.	Height in Inches.				No. exam-ined.	Height in Inches.	No. exam-ined.	Height in Inches.
2-3	M.	17	34'0	...	...	...	42	30'2	37	30'7
	F.	15	33'6	...	...	...	39	29'9	37	30'1
3-4	M.	34	35'5	...	...	...	48	33'3	29	31'9
	F.	34	35'2	...	...	...	46	32'5	43	31'9
4-5	M.	36	37'7	...	...	...	46	36'8	37	36'3
	F.	46	36'7	...	...	...	31	35'5	28	34'5
5-6	M.	30	38'5	40'0	...	41'0	45	38'8	23	37'4
	F.	36	40'0	39'9	...	40'8	32	38'2	26	39'0
6-7	M.	42	41'1	41'9	41'6	44'0	40	41'1	24	38'8
	F.	47	42'2	41'6	41'9	42'6	25	40'3	22	41'2
7-8	M.	28	42'8	43'7	45'4	46'0	22	43'5	...	...
	F.	31	45'2	43'4	44'8	44'5	15	42'2	...	...
8-9	M.	20	45'9	45'8	47'3	47'1	...	...	...	...
	F.	39	46'4	45'2	46'6	46'6	...	...	...	...
9-10	M.	15	47'4	47'7	49'3	49'7	...	...	...	...
	F.	21	48'4	47'2	48'5	48'7	...	...	...	...

hospital children are rather less than those of the standard, the differences being $1\frac{1}{2}$ inches at the age of 5, and slightly over half an inch at the ages of 6 and 7, while those for the ages of 8 and 9 are the same in both instances. The greater discrepancy at the age of 5 may be accounted for by the fact that only selected healthy children are sent to school at that age. On the other hand, the female children are taller than those of the Glasgow standard by 1 to $1\frac{1}{2}$ inch at ages 7, 8 and 9 years. However, when males and females are combined, the average is close to that given by Dr Mackenzie.

TABLE II.—Weights, on Admission and on Dismissal.—Ages 2-10 compared with Standards.

Age.	Sex.	Scarlet Fever.			Glasgow Mean Weights (MacKenzie).	Glasgow Mean Weights (Kay).	Anthrop. Comm. Stand. Mean.	Measles.			Whooping Cough.		
		No. examined.	Admission.	Dismissal.				No. examined.	Admission.	Dismissal.	No. examined.	Admission.	Dismissal.
2-3	M.	16	26.4	29.3	...	...	...	42	23.4	25.9	44	23.2	25.9
	F.	15	25.1	27.7	...	...	...	43	22.3	24.6	39	21.9	24.3
3-4	M.	38	29.7	33.7	...	...	...	51	25.8	29.8	30	25.8	27.1
	F.	35	28.3	33.4	...	...	...	48	24.6	27.5	42	25.5	29.0
4-5	M.	36	32.2	36.6	...	...	...	45	30.2	33.3	40	30.5	33.5
	F.	45	31.2	35.5	...	...	...	31	29.0	32.7	30	30.1	32.2
5-6	M.	30	36.6	40.7	38.6	...	39.9	43	33.8	36.9	26	31.3	34.9
	F.	36	33.7	38.8	37.8	...	39.6	33	32.0	35.4	27	34.3	37.8
6-7	M.	40	40.9	44.5	41.8	39.1	44.4	40	36.8	40.0	25	35.5	40.3
	F.	49	38.3	43.2	40.6	37.8	42.4	24	33.5	37.4	22	34.5	39.6
7-8	M.	28	42.7	47.0	45.3	46.2	49.7	22	38.4	42.1	...	...	...
	F.	31	40.7	45.7	43.9	43.7	46.7	15	37.6	41.8	17	38.2	42.4
8-9	M.	20	49.0	56.1	49.3	49.1	54.9	11	38.8	43.0	...	...	...
	F.	37	45.8	51.8	47.5	45.7	52.2	10	41.0	44.0	...	...	...
9-10	M.	15	49.8	58.9	53.6	51.9	60.5	...	...	...	...	...	...
	F.	21	48.8	54.6	51.9	51.8	55.5	...	...	...	...	...	...

The weights on admission of both male and female hospital children are less by amounts varying from 2 to 4 lbs. than those of the corresponding age groups of Dr Mackenzie's standard, while the same children on dismissal are heavier than those of the standard by an almost similar amount. Thus, as regards height, the Scarlet Fever child has been found to represent the average Glasgow child closely; and, as regards weight, a line intermediate between the admission and dismissal weights of the age groups ages. It is a fair inference to assume that this will also hold for children under school age.

The figures relative to the Whooping Cough and Measles groups may now be compared (Chart I.) with the standard obtained from the measurements of the Scarlet Fever group. This comparison shows the inferiority in height of the children admitted with Measles and Whooping Cough (representing the poorest type of Glasgow child) to the child with Scarlet Fever at all ages, with the exception of ages 7-8. The discrepancy at the ages of 3 and 4 is furnishes a fairly accurate standard for Glasgow children at school notable, being from $2\frac{1}{4}$ to $3\frac{1}{2}$ inches in both males and females. These measurements are all the more suggestive since they apply to non-rachitic children. It is to be noted that the heights tend to reach the standard at the age of 5, and there would appear to be a very notable recovery of physique about the period of commencing school age, without any apparent betterment in surroundings, or else the mortality amongst children of ages 2-4 is confined to the physically inferior children, which are thus weeded out by death.

It may be inferred from this that children are most susceptible to debased conditions at the period of life anterior to school age.

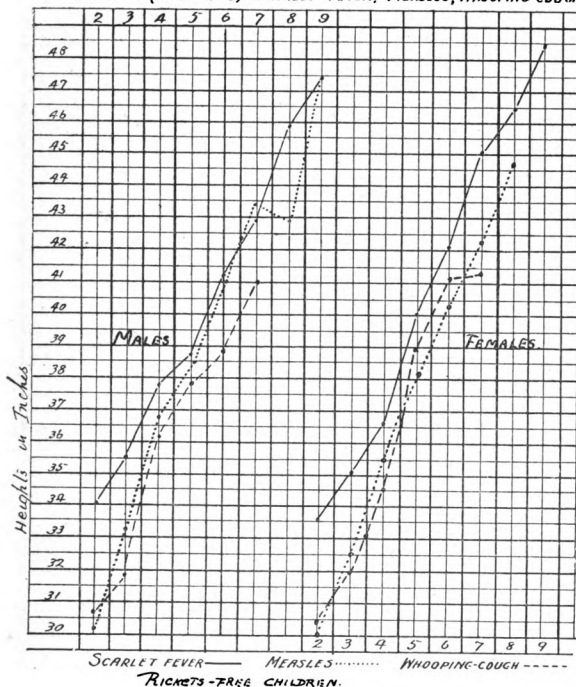
The weights follow a similar gradation (Table II.) Weight, however, is liable to suffer from nutritional changes occurring, possibly to an unequal extent, during the incubation periods of the several infectious diseases.

The relation of environment to physique was studied by analysis of the housing conditions of the same children. The investigations of Dr Chalmers and Dr Mackenzie on Glasgow school children threw into prominence the fact that the physical development of the child varied with the size of the house in which it was reared. Our hospital statistics corroborate these results, as will be seen by reference to Chart II. In this Chart the children from one, two

and three apartment houses are compared in respect of height at the various ages from 2 to 9 years, irrespective of the disease for which they were admitted. Here also, as in Chart I., rachitic

CHART I

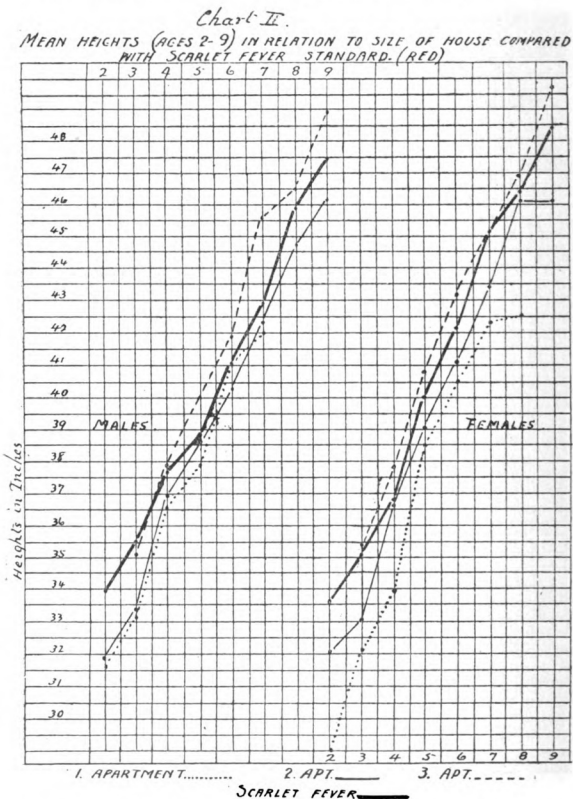
MEAN HEIGHTS (AGES 2-9) SCARLET FEVER, MEASLES, WHOOPING-COUGH.



children are excluded. For comparison, the figures showing the mean heights of the Scarlet Fever group, which we have shown to represent the average Glasgow child, are introduced.

It will be noted that at all ages the mean heights increase with the size of the house from which the child comes. The superiority

of the three-apartment group over the two-apartment group is most marked, and is decided (1 inch to 3 inches) at all ages in both sexes. The children of this group are also uniformly taller than



those of the Scarlet Fever standard. The one-apartment child compares unfavourably with the child from the two-apartment house. In the case of the males, the differences are not marked.

In the female groups, the differences are more notable, especially at the ages of 2 and 3, where a remarkable discrepancy exists between the heights of the one and two apartment child and the standard. A similar contrast exists between the heights of the Measles and Whooping Cough children and the Scarlet Fever children at those ages (2 to 4). It would appear that the child who takes Whooping Cough or Measles at ages 2 to 4 is $2\frac{1}{2}$ to 3 inches shorter than the child contracting Scarlet Fever.

TABLE III.—*Heights of total Children, graded according to the size of the House. Heights of Rachitic Children are tabulated separately.*

Age.	Sex.	One Room.		Two Rooms.		Three Rooms.		Rickets.	
		No. exam-ined.		No. exam-ined.		No. exam-ined.		No. exam-ined.	
2-3	M.	48	31'6	42	31'7	...	...	48	30'2
	F.	37	28'8	47	32'1	...	...	33	30'2
3-4	M.	41	33'2	58	33'7	11	35'2	48	31'8
	F.	43	32'1	67	33'0	13	35'3	47	31'9
4-5	M.	46	36'7	61	37'0	10	37'9	49	36'0
	F.	30	33'9	66	37'1	9	37'8	37	34'2
5-6	M.	33	37'8	53	38'6	12	40'2	28	36'0
	F.	27	38'5	54	39'0	13	40'7	20	37'7
6-7	M.	30	41'1	58	40'3	17	41'9	17	37'7
	F.	19	40'5	64	41'1	13	43'3	16	38'5
7-8	M.	17	42'0	32	42'3	...	...	8	38'0
	F.	15	42'3	42	43'4	...	...	14	42'2
8-9	M.	...	...	20	44'7	8	46'5	...	...
	F.	...	...	28	46'2	17	46'8	...	...
9-10	M.	...	...	14	46'2	...	...	...	...
	F.	...	...	15	46'2	...	...	...	...

There is thus clearly demonstrable a distinct connection between height of child and social status, of which the size of the house is the best index. These gradations cannot be casual, and would appear to indicate that bad housing and poor feeding considerably retard the growth of the child, particularly during the earlier years of life.

We may now consider the evidence bearing on the capacity of the children from the various classes to improve under hospital conditions. The children were systematically weighed, and their heights measured, both on admission and on dismissal. It must be

remembered that these figures refer to increase in height and weight during convalescence from acute disease, which of itself is known to determine a considerable acceleration of growth in some instances. That this does occur is undoubted, but its frequency has been much overstated, particular attention having been paid to selected instances of conspicuously rapid growth during convalescence. The amount of increase in height after fevers has been fully discussed by Dr Arnold Gray in a paper on *The Laws of Individual Growth*, read before this Society on 7th April, 1909. He pointed out that the mean rate of increase during hospital residence after Scarlet Fever, Diphtheria and Measles did not exceed the normal rate of growth. In Whooping Cough, however, the rate of increase was considerably in excess.

As regards weight, in Table II., the mean admission and dismissal weights for the age groups 2-9 are compared for Scarlet Fever, Measles and Whooping Cough. The average duration of hospital residence of the child with Scarlet Fever is 8·04 weeks, with Whooping Cough 8·38 weeks, and with Measles 3·74 weeks. In the case of males it will be noted that the increase is throughout greatest in the Scarlet Fever group, and least in the Whooping Cough group, over much the same period of observation. For females this also obtains for ages 2-6 years; at ages 7-9 the difference is much the same in both cases. Measles children, on the other hand, with an average period of residence of less than half that of either Scarlet Fever or Whooping Cough, show a general increase over all ages of scarcely less than that of the Scarlet Fever group. The factors studied, however, appear too liable to be influenced by pathological conditions to allow general deductions to be made regarding the physique of the groups studied. For instance, Whooping Cough is associated with vomiting, and is liable to be followed by long-continued bronchopneumonias, both of which tend to induce a marasmic state, although, on the other hand, children are not dismissed until convalescence is thoroughly established.

An account has been given of the increase in height and weight of the various age groups of children during their residence in hospital. This, however, gives no indication of the relative numbers taking part in the mean or general increase. Children from the slums, while of an inferior class generally, exhibit great variability in physical condition, and it was thought might show

also very unequal capacities for improvement. It was strongly suspected that a considerable group might not respond at all to better conditions, but constitute an unimprovable residuum. Whether this is the case to any extent can be determined statistically by comparing the standard deviations of the age groups on admission and on dismissal. A diminution in the standard deviation on dismissal indicates that the units composing the group have approached the mean and have become more compact, and that there is no unimprovable tail, while an increase indicates that the group is more scattered and that certain children have improved more than others, who have remained almost stationary and unimprovable. The improvability is measured by the increase in the

TABLE IV.—*Standard Deviations¹ of children from one and two apartment houses in respect of admission and dismissal weights.*

	AGE GROUP—2-6 YEARS.			
	One Apartment.		Two Apartments.	
	No. of Cases.	Standard Dev.	No. of Cases.	Standard Dev.
On Admission ...	310	= 2'4698	437	= 2'2136
On Dismissal ...	282	= 2'2583	400	= 2'1909

mean weight during residence in hospital, and the uniform nature of this is shown by the standard deviation remaining nearly constant. If the latter is increased, then it is evident that the group has not improved equally, and that there is a percentage of children showing little response to hygienic conditions.

These figures would appear to indicate that the "tail" of the group is more improvable than the better child, more notably so

¹ Almost all groups of measurements as regards man are closely represented

by the curve $\gamma = \gamma_0 \times e^{\left(-\frac{x^2}{2\sigma^2}\right)}$, the number of cases having mean value being given by γ_0 and the degrees of scatter by σ which is called the standard deviation; the larger σ is, the more cases there are differing from the mean above and below, and the smaller the value of σ the more closely are the cases gathered about the mean.

in the case of the one-apartment group, but the numbers are not sufficiently large to make this certain.

The figures for the several age groups 2-4, 4-6 and 6-8 years show that at the younger ages the tendency is for the dismissal groups to be more compact than the admission groups.

TABLE V.—*Standard Deviations of the age groups 2-4, 4-6, 6-8, on admission and on dismissal, for children from one and two apartments.*

					Males.			Females.		
Age	...	...	...	...	2-4	4-6	6-8	2-4	4-6	6-8
One Apartment	{	Admission	...		2'68	2'49	2'25	2'19	2'39	1'55
		Dismissal	...		2'24	2'39	2'25	1'92	2'45	1'48
Two Apartments	{	Admission	...		2'17	2'14	3'00	2'39	2'19	2'41
		Dismissal	...		1'97	1'87	2'91	2'41	2'41	2'53

Rickets.

In every case note was taken of the presence or absence of rickets. The data tabulated included in addition to (a) the height of the child, (b) the size of the house from which it came, and (c) the position of the house in the tenement (d), the birth-place of the child, and also of its parents.

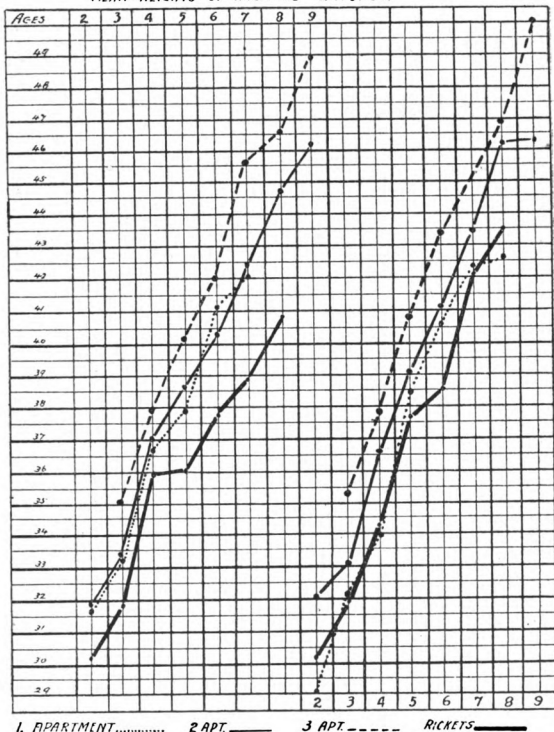
Of 1357 children between the age of 2 and 10 years rickets was observed among males to the extent of 31 per cent., amongst females to 26·7 per cent. Of 329 children between 6 months and 2 years the incidence among the combined sexes was 42·5 per cent. In Table VI. the incidence among hospital children is compared with that given for school children in Dr Chalmers' report previously mentioned.

The rachitic child has been found to be of smaller stature than the non-rachitic child at all ages. In Chart III. a comparison of the mean heights is made with those of the children from the one, two and three apartment houses. The male rachitic child is uniformly less in height than even the non-rachitic child from the

one-apartment house, this difference becoming notable, and amounting to 2-3 inches, at ages from 5 to 8 years. The female rachitic child has practically the same height (except at the age of

Chart III

HEIGHTS OF MALE & FEMALE CHILDREN IN RELATION TO SIZE OF HOUSE COMPARED WITH MEAN HEIGHTS OF RACHITIC CHILDREN.



6) as the non-rachitic child of the one-apartment house. This fact along with the lesser incidence of rickets among females would appear to indicate that females suffer from recognisable

rickets less frequently, and show less retardation of growth than males.

When the influence of housing accommodation in determining the incidence of rickets is inquired into, it is found that the same conditions that effect retardation of growth of the normal child, operate powerfully on the susceptibility of the child to rickets.

TALBE VI.—*Table of Rickets Incidence.*

RICKETS AMONG SCHOOL CHILDREN—DR CHALMERS.¹

No. of Apartments in House.	No. of Children.	Rickets per cent.
One Apartment,	84	21·5
Two Apartments,	637	23·5
Three Apartments,	440	24·3
Total,	1161	

RICKETS AMONGST HOSPITAL CHILDREN.

Age 2-10 Years.	No. of Children.	Rickets per cent.
Males,	682	31·0
Females,	675	26·7
Age ½-2 Years—Males and Females,	329	42·5
Total,	1686	

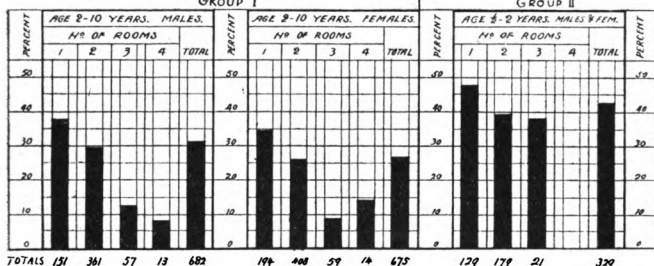
The analysis of the data relating the incidence of rickets to (a) the size of the house and (b) its position in the tenement is given graphically in Diagram A, p. 16. Separate analyses were made for the age groups ½ to 2 years, and 2 to 10 years, the former period covering the age of greatest susceptibility to rickets (1-2 years). A further object of this subdivision was to discover whether any difference could be shown to occur in the incidence

¹ "Physical Inspection of School Children in Relation to Public Health Administration." By A. K. Chalmers, M.D.

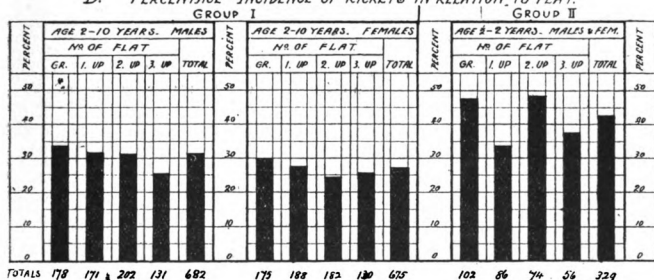
of rickets in the various flats sufficient to carry the interpretation that people with rickety children tended to move downwards in the tenement in order to have more easy access to the street.

As regards size of house, it will be noted that among male children of the age group 2-10 years from one-apartment houses,

A. PERCENTAGE INCIDENCE OF RICKETS IN X-ROOMED HOUSE.



B. PERCENTAGE INCIDENCE OF RICKETS IN RELATION TO FLAT.



37·8 per cent. were rachitic, the figures for two and three apartment houses being 29·6 per cent. and 12·2 per cent. respectively. For females the corresponding percentages are 34·5, 26 and 8·5. The total number examined was 1357. The corresponding figures for the age group $\frac{1}{2}$ to 2 years are not so striking, 47·3 per cent., 39·6 per cent., 38·1 per cent. for the several sizes of house, though they admit of the same interpretation. It will be noted that in the

case of the three-apartment group the number of cases is only 21. Dr Chalmers, however, found the percentage incidence of rickets among school children, according to house standard, 21·5 per cent., 23·5 per cent., 24·3 per cent. from one, two and three apartment houses respectively (Table VI.). The figures relating to the hospital children indicate that whether the actual incidence of rickets is less in the larger houses or not the children of the class inhabiting these houses show a much greater capacity for recovery from rickets than do those of the class inhabiting the smaller houses.

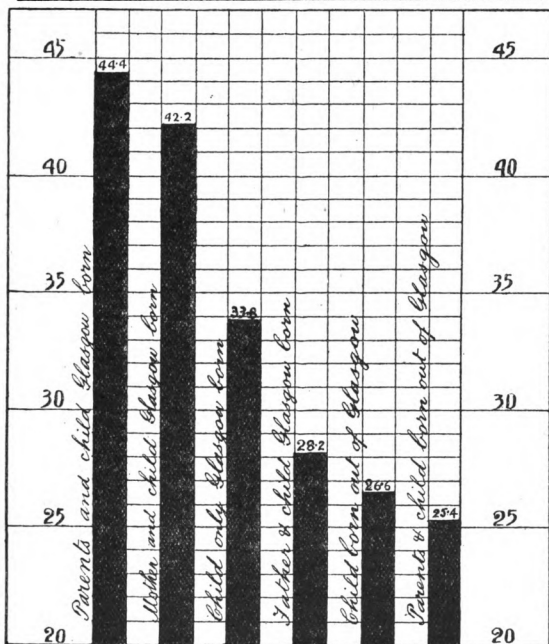
From Diagram B it would appear that the situation of the house in the tenement is almost negligible as a factor in the causation of rickets. In Group I., which contains the children of 2 to 10 years, a slightly higher percentage of rachitic children come from the lower flats in the tenement, while in Group II., containing children of ages 6 months to 2 years, the distribution appears to be independent of the flat. A further analysis of the one and two apartment groups of children separately yielded the same result. There is, therefore, no evidence that parents tend to consider that the position of their house in the tenement is a factor in the production of rickets. These facts contradict what has been frequently stated, that the numbers of rickety children increase in proportion to the height of the flat.

An analysis of the parentage of 1277 children was undertaken with a view to determining whether the susceptibility of the child to rickets depended to any extent on its own or its parents' birth-place. The Measles and Whooping Cough groups were selected for analysis, as furnishing the largest percentage of rachitic children. Out of 1277 such children between the ages of 6 months and 10 years, 571, or 40 per cent., were rachitic. These were variously related to Glasgow by birth or parentage, as shown graphically by Diagram C, which gives the proportion in which rickets was found to exist in the groups from the various sources indicated. The children and parents were broadly classified into "Glasgow born" or "not Glasgow born," the latter class including those from the country districts, neighbouring small towns, and a considerable number from Ireland and Russia. From these tables it appears that the percentage incidence of rickets among Glasgow-born children exceeds by 14·4 that among children not born in Glasgow, and by 15·5 that among children

who, along with their parents, are foreign to Glasgow. The prevalence of rickets among children imported into Glasgow slums is high, though it is not known what proportion of these children

DIAGRAM C.

DIAGRAM · SHOWING · RELATION · OF · RICKETS · INCIDENCE
TO · BIRTH · PLACE · AND · PARENTAGE · OF · CHILD,



had rickets before being brought into the city. It may, however, be said that country birth and parentage afford a considerable relative protection to the child against rickets. For instance, this disease occurs most frequently amongst children born in Glasgow of Glasgow parents (44.4 per cent. being affected) less so when

the parents are foreign to Glasgow, but the child native born (33·8 per cent.), and least frequently of all where all three were born outside of Glasgow (25·4 per cent.).

The liability to rickets of a Glasgow native whose mother is also a native is considerably greater than that of the same child whose father alone is Glasgow born. From these results it may be inferred that the foreign origin of the parents, especially of the mother, affords some protection to the child against rickets, or at least against recognisable rickets, and that the Glasgow-bred mother in particular has quickly succumbed to the debilitating influences of city life. Unfortunately there are no data relating to the relative severity of the disease among the classes considered.

The mortality among rachitic children from Measles or Whooping Cough, between the ages of 6 months and 2 years, was 32·8 per cent., as compared with 21·1 per cent. in case of non-rachitic children.

It was intended to discuss the frequency of rickets among the earlier and later children of the same family, but the data collected were found to be insufficient for this purpose.

APPENDIX.

On the Relationship between the Weight of the Infant and its Susceptibility to Zymotic Disease.

The number of children under the age of one year whose weights were taken on admission was not large enough to allow of classification according to the size of the house in which they were reared. They were, therefore, grouped together, in order if possible to obtain a standard weight for the Glasgow child from birth up to the age of one year. For comparison the only data available are those relating to the infants who attend the milk depôts, and it has been thought advisable to use Kempton's Physiological Nursery Chart as a standard of comparison.¹ That such a standard is necessary is evident on examining the curve

¹ These curves of increase in weight (Diagram D) are taken from the Annual Report of the Medical Officer of Health for Glasgow, 1907.

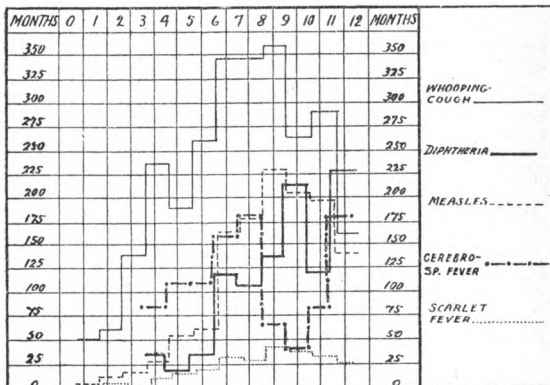
representing the admission weights of the hospital children. This curve should, *a priori*, be one of gradual increase, even although it should become less steep as age advances. In the cases considered, however, the curve after ascending moderately uniformly from 3 to 6 months has its continuity suddenly broken, and descends to an unexpectedly low level, and only regains its natural position as the end of the first year is reached. This divergence of the hospital weights from those of the standard is of a quite different kind from that observed in the charted weights of the children weighed at the milk depôts. In the case of the latter all the evidence points to digestive disturbance as a cause of the retarded increase in weight. Among the hospital children, however, the defect is so striking as to demand special explanation. The time of weaning could hardly be expected to explain this, since the data based on the depôts' measurements yielded no phenomenon at all comparable. When, however, the weights are compared with the susceptibility to zymotic disease of children at the several age periods, some points in the physiology of infant life seem to emerge (Diagram D.). There are certain peculiarities in the distribution of this susceptibility to zymotic disease among young children. In the cases of Measles, Whooping Cough, and Scarlet Fever, a period of special susceptibility begins at the sixth month, reaches a maximum at the eighth and ninth months, and thereafter falls, as shown in the accompanying diagram.¹ The curve of the age distribution of Diphtheria and Cerebro-Spinal Meningitis shows that the sixth and seventh months are periods of special susceptibility, although these diseases differ from the former three in the comparative infrequency with which children under the age of one year are affected. In the case of Diphtheria alone does the incidence tend to uniformly increase from birth up to one year.

It may also be noted that there is a parallel increase in the severity of Measles, Whooping Cough and Scarlet Fever as the first year advances. The mortality in the case of Measles and Scarlet Fever is 50 per cent. less, and in the case of Whooping Cough 25 per cent. less, during the first six months of life than during the second six (Dr Brownlee). It would seem that there is a

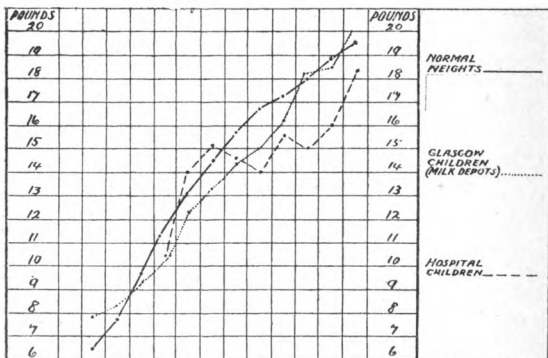
¹ Taken from the Annual Report of the City of Glasgow Fever Hospital, Belvidere, 1902. (Dr Brownlee.)

DIAGRAM D.

DIAGRAM SHOWING THE RELATIVE PROPORTIONS IN 10000 CASES OF PERSONS AT EACH AGE-PERIOD FOR SCARLET FEVER, MEASLES AND WHOOPING-COUGH



Each Square = 25 cases, and its horizontal side represents periods of one month.



Statistics relating to Scarlet Fever, Measles and Whooping Cough are based on admissions to Belvidere Fever Hospital from 1886 to 1902; the Diphtheria curve relates to cases admitted from 1901 to 1908; the curve for Cerebro-Spinal Fever to admissions from 1906 to 1909.

remarkable variation in the powers of immunity displayed by infants about the age of six months. When these facts are considered in relation to the weights of the hospital child population, it appears that undersized children especially fall victims to zymotic disease, for the loss in weight can hardly be due entirely to the initial disturbance of nutrition either during the incubation period or during the early stages of the fever; the same phenomenon is not observed between the ages of three and six months, nor at the age of eleven months, but is specially confined to a limited period in the child's life. The data at our disposal do not permit of this point being thoroughly investigated, but suggest lines on which future inquiry might be made.

SUMMARY.

In the foregoing pages statistics bearing on some aspects of the physical state of Glasgow children are analysed. The inquiry has had particular reference to certain of the factors underlying the relationship between physical condition and standards of life, this being conveniently indicated by a classification of the children into groups according to the size of the house from which they were drawn. Adopting this gradation we find that each class has its own standard of physique, the discrepancy in height between the poorer and better groups of children being considerable at all ages, particularly at ages prior to school life. It would appear that between the ages of 2-4 the influence on height of poor surroundings is most marked, but it will also be noted that some recovery of physical vigour is apparent when the school period begins at the age of 5 years, and that without any particular betterment in the conditions of life (a fact also noted by Eichholz). These facts are based on comparison with the measurements of the Scarlet Fever child as a standard, which has been found to agree pretty closely (with reference to school ages) with the existing Glasgow standard (Mackenzie). Height is made the chief criterion of physique, as weights are liable to be interfered with, in young children especially, by the nature and severity of the disease present on admission. Certain points bearing on the relationship of the weight of the infant to its susceptibility to zymotic diseases are discussed in an appendix. Weight measure-

ments as a test of immediate nutrition are made use of in studying the capacity of the slum child to benefit by residence in hospital. It has been shown that slum children as a group are quite amenable to improvement, and if there is no evidence that they become a more homogeneous group as regards weight on dismissal than they were on admission, they at least do not contain any considerable proportion of "wasters" or children failing to react to better surroundings. The improvement is manifested by the general mass, and there are few irreclaimables.

The retarding effect of rickets on growth is more evident among males than among females, which may be taken to mean that the disease is less severe, giving rise to less stunting of growth among the latter, and it may be noted that females have a rather less incidence than males, 26 per cent. as against 31 per cent. Rickets, as might be expected, prevails in proportion as the standard of life is debased, as will be seen from the comparative table of its incidence among children of one, two and three apartment houses. It was found that the position of the house in the tenement was a negligible factor in rickets causation in either of the age groups $\frac{1}{2}$ -2 years, or 2-10 years.

Diagram C shows the effect of city life generally in predisposing to the conditions that lead to rickets, and exemplifies the debilitating influence of city life on the power of the mother to suitably nourish her children. Further, it may be noted that the mortality among rachitic children of ages $\frac{1}{2}$ -2 years from Measles, Scarlet Fever and Whooping Cough is 32.8 per cent., and among non-rachitic children 21.1 per cent.

The Sources of the Hamlet Tragedy.

By JAMES D. FITZGERALD.

[Read before the Historical and Philological Section,
25th November, 1908.]

THE question of the original sources of *Hamlet* has long been discussed by the critics; but the investigation has as yet yielded very little of practical value—little that can help us to conceive how the tragedy took shape in the mind of the poet, or aid us in our attempts to determine his general intention in writing the drama. In one particular line of enquiry, indeed, criticism has recently reached what may be regarded as a fixed conclusion of some importance. Shakespeare is generally supposed to have made use of an earlier play founded on the *Hamlet* legend, and ascribed with more or less confidence to Thomas Kyd, author of the *Spanish Tragedy*: the existence of that early *Hamlet* tragedy and Kyd's authorship of the same would now seem to have been placed beyond the reach of doubt by the researches of the German scholars, Sarrazin and Schick. Further progress, however, in this direction is barred by the fact that no copy of Kyd's *Hamlet* exists at the present day; and Shakespeare's indebtedness to it as one of the actual sources of his own play is, therefore, very much a matter of speculation, upon which criticism may continue to exercise its ingenuity without much hope of any substantial gain. But if we are unfortunately denied the opportunity of comparing Shakespeare's play with that of Kyd, we are thus forced back, it would appear, upon the *Spanish Tragedy*, a dramatised story of revenge happily in our hands to-day, having a "ghost" of its own and a "play within the play," so that it may well afford us some useful parallels to illustrate both the plan and the meaning of *Hamlet*. But the *Spanish Tragedy* loses much in interest and weight just because we are compelled to use it as a substitute for the lost *Hamlet* of Kyd, a work we are naturally inclined to think of as having had a much more direct and decided influence on the inception and growth of Shake-

Shakespeare's tragedy. Be that as it may, the writer of this article cannot but feel that criticism at the present time is wasting itself on the thankless task of guessing to what extent Shakespeare may have been indebted to Kyd, when there lies open to us a field of investigation promising richer and more certain results than can be expected in any other direction. It has always been understood that Shakespeare himself must have had some direct acquaintance with the *Hamlet* story in one or another of its narrative forms; and whatever may have been the influence upon his "mind and art" of the tragedies of Kyd, it is surely of the very first importance that scholars should, if possible, ascertain in what particular form our great dramatist used the ancient legend; how far he thought fit to follow it in shaping his own tragedy; and why in any of its important details or outstanding features he departed from it. First things should be dealt with first; and there is some reason to fear that criticism is at this moment paying the penalty for deferring too much to the supposed influence of Kyd, and neglecting the only available source of Shakespeare's *Hamlet*. It seems to be following the wrong trail in matters both of the lower and the higher criticism. To give one example of the more serious type of mistake—it has gone wrong in trying to establish a connection between the moralisings of the "play scene" in *Hamlet* and Kyd's translation of *Cornelia*, whereas the true and immediate connection is with the *Hamlet* legend. For Prof. Boas, in his valuable introduction to the *Spanish Tragedy*, is surely mistaken when he regards Shakespeare, in the scene just referred to, as interested in the evils following upon second marriage, and thinks that this subject was suggested to him by the *Cornelia* of Kyd. What Shakespeare is really interested in is the folly of uxoriousness in any marriage, first or second; and he found that theme strikingly illustrated, not in *Cornelia*, but in the *Hystorie of Hamblet*, where the hero is depicted¹ as "besotted on his wife," and where this weakness is the one blot upon his reputation as well as the immediate cause of his ruin and his death. This folly, moreover, lies at the very foundation of the tragedy, in which the dramatist has boldly transferred it to the older from the younger Hamlet, to the father from the son. Uxoriousness is the human weakness from which the fires of

¹ See No. 19 in Tabulated List.

purgatory have not entirely freed the ghost of the murdered king—the folly that is made so impressive in the figure of the player-king, imported into the play to remind us, in a scene of central importance, of this most bitter root of the tragic environment.

But if some version of the ancient *Hamlet* story is always taken for granted as having been available for Shakespeare, just as it seems to have been for Kyd before him, is it not more than strange that at this date in the literary history of the play there is no consensus of opinion as to the special form of the story that was actually in Shakespeare's possession—certain authorities holding that he may have used the French version of the legend written by Belleforest in 1570; others regarding him as having used some English translation of Belleforest, such as they are inclined to think may have been published before 1603, the date of the *First Quarto* edition of the great tragedy? Had there been any very careful or painstaking search for evidence on the subject, it is clear that such a discussion as this would have been rendered superfluous. Perhaps there has been a general impression on the minds of students of the play that, if Shakespeare's knowledge of the *Hamlet* story were accepted as a fact, the mere form of the story might be regarded as of little consequence. It is to be feared, however, that this slipshod indifference has done something to discourage any exact or thorough comparison between the tragedy itself and the story on which it was supposed to be founded; and it is surely full time to face the question frankly, and, if possible, to settle it once for all. Mr Sidney Lee, for one, in his *Life of Shakespeare* and elsewhere has favoured the supposition that Belleforest's rendering of the *Hamlet* story was accessible to the dramatist, and that his knowledge of French was sufficient to enable him to take advantage of it. Some good reasons will be given in the sequel for believing that Shakespeare had some acquaintance with the French version; but evidence will be led to show that an English translation of Belleforest was also in the hands of the dramatist, and was used by him to such an extent that the French form of the legend may practically be ruled out of account. To such a conclusion the writer has been forced by a careful comparison instituted between the text of the tragedy and that of the translation known as the *Hystorie of Hamblet*. The results of that comparison are shown in the tabulated list at the close of this paper,

and students of the *Hamlet* literature should not find it difficult to draw their own conclusions from the material thus presented for their convenience; the following remarks, however, may not be thought unnecessary in the endeavour to enforce and illustrate the significance of these results.

Of late years, an unfortunate prejudice has been created against the *Hystorie of Hamblet* as a possible source of Shakespeare's play, because some scholars of repute have favoured the view that it was not written before the tragedy, but is of more recent date. They rely upon the fact that the earliest copy extant was printed in 1608. Its publication in that year, as a separate story taken from *Les Histoires Tragiques* of Belleforest, they attribute to the great interest in the legend created by the popularity of the tragedy; and in a few specific details where the translation differs from Belleforest they suppose the translator to have copied from Shakespeare. For in the *Hystorie* the spy is made to hide behind the "hangings or arras" instead of under a "quilt" as in Belleforest, and Hamlet when he stabs him is made to cry "a rat, a rat"—details in the insertion of which the translator is thought to have yielded to the influence of the play already established as a favourite in the theatre.

Those who advocate this view of the connection between the English translation and the tragedy would seem to have been too easily induced to believe that the details just referred to are the only correspondences in phraseology to be noted between the *Hystorie* and Shakespeare's play. Furness, for example, in the *Variorum Shakespeare*, not only gives his emphatic approval to the conclusions arrived at by Karl Elze—that the prose version is of later date than the drama, and that the former shows traces of the influence of the latter—but he goes the length of saying that Elze might have added to the strength of his contention by insisting on the fact that the two details (the arras and the rat) afford the only examples of phraseology common to both.

This verdict of Furness some of our authorities have been content to repeat and confirm. Professor Hall Griffin—to quote one of these—writes as follows: "Presumably the well known success of Shakespeare's *Hamlet* led a venturesome printer to employ a feeble anonymous translator to put forth this particular *Hystorie* in a separate form:" and in almost identical terms we might quote from Dowden, Gollancz, Brandes, and Verity. These

scholars, however, cannot be said to have served themselves heirs to an unbroken tradition; for such editors as Capell, and more recently Dyce and Collier, have held that the *Hystorie of Hamblet* was really in the poet's possession, and that the 1608 edition was not the first to be published, although no earlier copy has as yet been discovered. And though it may seem strange that the frequency and significance of the correspondences between the *Hystorie* and the play—the very correspondences that have suggested the writing of this article—should have escaped the notice even of some who are firmly convinced that the *Hystorie* is the source of the tragedy, we need not take it for granted that all of them have been equally remiss or unobservant. Hunter, for instance, the editor of *Longman's Series*—while quoting Capell to the effect that none of the translator's expressions have got into the play, except when Hamlet kills the Counsellor behind the arras and cries out a rat! a rat—on his own initiative adds a few correspondences that he had chanced upon when selecting extracts from the *Hystorie* for his introduction to the play.

The mere fact, however, that it has been possible for some of the scholars we have mentioned to doubt if not to deny that there is any close connection between the two texts, is sufficient to show that no thorough comparison has ever been made between them, and that the claims of the *Hystorie* to be one of the direct sources of the tragedy have never been set forth in their full strength and impressiveness; and this uncertainty, it is to be feared, is accountable for much of the indifference to the origins of the drama that may be observed in all the earlier and much of the later criticism. If these claims, however, were once firmly established and frankly acknowledged—a result the writer of this paper has some reason to anticipate—students of *Hamlet* would feel encouraged to make a more frequent and intelligent use of the *Hystorie* than they have hitherto done, whether in matters directly connected with the text of the tragedy or in questions regarding its general scope and meaning. And to speak first of the interpretation of the play—might it not be a boon to criticism if, after all the long years of debate, it should be forced back upon a consideration of the origins? Doubtless some attention has been given to these in the past, but it has been too slight and superficial to yield much in the way of tangible result. It is a very uncommon thing, indeed, to find an interpreter defending his interpretation, either in whole or in part,

by any serious reference to Shakespeare's use of the old *Hamlet* story. But until he has done that, he has not done all he might have done to test the validity of his opinions and earn the confidence of his readers. And all students of the play who have tried to form some conception of its meaning without prepossession or prejudice, by what seemed to them a strictly impartial analysis of its literary contents, should be induced to go one step farther. Let them examine the old story for the purpose of discovering what features of it the poet has retained and what he has rejected as unsuited to his general intention. More especially let them try to discover what idea Shakespeare was likely to form of the career and character of the ancient hero as portrayed in the *Hystorie of Hamblet*, and then proceed to enquire to what extent and for what reason he has made his own hero to differ; why he has turned a somewhat commonplace story of revenge into a vendetta conducted under the most extraordinary conditions, and why he has chosen one like Hamlet to figure there. For—to make our meaning a little clearer—is there not an enormous difference between avenging a murder of which nobody has any reason to doubt, and punishing one of which not a soul in the tragedy is ever permitted to hear, except the avenger himself, a Ghost who has revealed the secret, and a single friend to whom the secret is confided—Horatio—who is saved by accident to give the necessary explanation, but who has not named either the murderer or the murdered man when the curtain is finally rung down. Is not this the difference between a straightforward story of stirring adventure and a psychological extravaganza depicting a romantic morbid mood, which may be—as the poet describes it—consistent enough in itself, but which it is hopeless to explain on commonplace, prosaic lines? The ancient hero is one whose career of rude, but clever, self-achieved success raises him high in the envy and admiration of men, and gives him abundant cause to congratulate himself. Shakespeare's Hamlet is dead to self and doomed to failure; yet his is a failure that has witched the world.

But a comparison between the two texts we are dealing with may prove advantageous in other ways. It may afford, for example, a fresh illustration of the phenomenal acquisitiveness and tenacity of Shakespeare's memory for words and phrases—a gift that may be measured by his great vocabulary to which he

never ceased to add. For no matter how commonplace in diction any of his sources chanced to be, the text would seem, not only in very occasional words and phrases but after a fashion that might be called wholesale, to have been appropriated and utilised with all the unconscious ease of genius to express the poet's noblest thought. The *Hystorie* is admittedly a very unattractive version of the *Hamlet* story without a touch of literary grace or vigour; and yet how much of its phraseology has passed through Shakespeare's working memory into the lines of his great masterpiece! Sometimes the coincidences between the *Hystorie* and the tragedy are little more than the repetition of single words or simple phrases; but sometimes they are so complex in form that one is tempted to believe the dramatist must have worked with the book spread open before him. At other times, again, phrases of more than ordinary significance are transferred, as if by a freak of memory, from one incident in the *Hystorie* to quite another incident in the play; or it may be that phrases that are distinct and even widely separated in the former are run together in the latter, as if the poet's memory had been saturated in the original source, and, like the dyer's hand, "subdued to what he works in." By way of adding to Shakespeare's vocabulary of single words, a poor and commonplace text like that of the *Hystorie* could not be expected to do much if anything; but as one such indubitable addition the word "vanquisher" may be mentioned,¹ since, apart from the passage in our list of extracts, it never occurs again in all his plays, except once in *Coriolanus*—a tragedy of later date.

But again, a comparison between the texts of the *Hystorie* and the tragedy should prove of considerable service in the solution of a very difficult and complicated problem that has long taxed the ingenuity of students of the play. This problem is to decide what is the true character of the edition known as the *First Quarto*, and especially to determine how far that may be regarded as a true Shakespearean drama, though we have it now in what seems a sorely mangled and mutilated condition. The editors of the *Clarendon Press Shakespeare* (Clark & Wright) may be instanced as giving a somewhat extreme view of the matter. Their opinion is "that there was an old play on the story of Hamlet, some portions of which are still preserved in the Quarto

¹ See No. 1 in Tabulated List.

of 1603; that about the year 1603 Shakespeare took this and began to remodel it for the stage, as he had done with other plays; that the Quarto of 1603 represents the play after it had been retouched by him to a certain extent, but before his alterations were complete; and that in the Quarto of 1604 we have for the first time the *Hamlet* of Shakespeare." More briefly they say "that the text of the *First Quarto*, imperfect as it is, represents an older play while it was undergoing a remodelling but had not received more than the first rough touches of the great master's hand." This position, with regard to the *First Quarto*, involves a considerable departure from that formerly assumed by the same scholars in the *Cambridge Edition*, where they held "that the chief difference between the *First* and the *Second Quartos* are only such as might be expected between a *bona fide* and a *mala fide* transcription of the same play;" and it is perhaps unfortunate that in a later edition of the *Cambridge Shakespeare* Mr W. Aldis Wright should have so emphatically expressed his adherence to the changed opinion as being one from which he "could see no reason to dissent." For there is good cause to think that the trend of criticism is now in favour of the view set forth in the early *Cambridge Edition* and away from that expressed in the *Clarendon Press*. Professor Dowden, for instance, in the *Arden Shakespeare* gives a much more generous estimate of the amount of work to be credited to the dramatist as his share in the authorship of the *First Quarto*. He seems to think that little if any of the old play can be detected in it; he sees nothing in it that looks pre-Shakespearean, and much that is entirely unlike the work of Kyd; and finally he is satisfied that Shakespeare's hand can be discerned throughout the whole of what he calls "the truncated and travestied play of 1603."

In the face of this conflict of opinion, does anything result from our examination of the *Hystorie of Hamblet* to enable us with confidence to take either the one side or the other; to entitle us to say whether the *First Quarto* ought to be regarded as an old play undergoing a process of amelioration at Shakespeare's hand, or as a genuine and mature work of his, which has suffered degradation unspeakable, but which from beginning to end affords evidence of his august workmanship, in spite of all mishandling, stupid, perverse, and manifold? Are we to think of this earliest edition as having been at the best an old play on which Shakespeare had been

experimenting, as an artist may work on the sketch of an amateur till he has caught a conception he means to embody in a painting of his own and can afford to toss the sketch aside. Mr Verity in the *Pitt Press Shakespeare* doubts whether the poet could have condescended to work upon terms so irksome to genius. "One may well be loth to assume," he says, "that in the plenitude of his powers Shakespeare would be content merely to revise and remodel." And certainly, if we may claim to have reached any firm conclusion in our examination of the *Hystorie of Hamblet*, it is to have ascertained that Shakespeare's work in the *First Quarto* deserves to be thought of as anything but tentative and piecemeal; for we have discovered new reasons to think that it was a carefully planned, well digested, and fully completed drama, whatever were the sources from which his rough material was taken. The test we propose to apply in order to justify such a conclusion is a very exacting one, since it is one to which the edition of 1603 must answer on equal terms with the current edition of the play, some allowance being made for the ruinous state of the text. The nature of that test will be easily understood. In the authorised copies of *Hamlet*, we have discovered upwards of 50 passages that seem to show some verbal correspondence with the *Hystorie*, and in the text of the *First Quarto* we find the same correspondences, in passage after passage, as exhibited in our tabulated list. It is true that we have to be content to number only 30 instead of 50 examples; more could hardly have been expected, taking into consideration the corruptions of the text along with the fact that the *First Quarto* comes short of the current play by nearly 1800 lines. But even as the matter stands, could any guarantee of Shakespeare's authorship be more decisive than the one just given? Does it not assure us that his relations to the work are most intimate and pervasive, as to a drama begun, continued, and ended by himself? For these correspondences are marks of life and growth in an organic whole. They imply that the author shaped the plot only after he had made such a study of the *Hamlet* story as his genius knew how to make of any of his sources, and after he had settled in his own mind how far he meant to adhere to the narrative in the *Hystorie* and where he meant to depart from it. Before he wrote a single line, he must have resolved to change the hero of the ancient legend into a character fitted to figure in a most sombre tragedy, and must have fixed his reasons for doing

so. His shaping imagination, therefore, would seem to have been responsible for the entire structure of the *First Quarto*, and these correspondences testify to that work as having been a living whole more convincingly than the *disjecta membra* of some ancient monster speak to us of the once living body with the flesh that clothed and the blood that nourished it. This is an indirect argument for Shakespeare's claim to everything in the *First Quarto*—except in so far as the *First Quarto* fails to reproduce the true and complete text, of which it seems always conscious even when the failure to record it is most evident and most absurd. But such an argument as this, drawn from the dramatist's familiarity with the *Hystorie of Hamblet*, will have its full weight perceived and acknowledged only when it is added to the arguments direct, which the writer hopes in a subsequent article to set forth more fully and forcibly than has yet been done by those who take the same view of the matter. He is convinced that the amount of Shakespeare's work actually embodied in the *First Quarto*, and suggested or presupposed where it is not accurately recorded, is so great that anything in the pirated edition that seems frankly different from the current play may be deemed a fraudulent substitution or imitation till it can be proved to be something more respectable.

Two points may here be adverted to, as going far to establish the fact that the correspondences given in our tabulated list are real, and not merely chance or imaginary coincidences. One is that these correspondences almost entirely cease in large tracts of the play; they fail to appear in the very scenes where Shakespeare's plan passes beyond the limits of this particular source. It may be reckoned, when some exceptional expressions, such as "Hamlet the Dane," are left out of account (as likely to crop up in any part of the work), that these scenes taken together make up fully half the play. We may assert, then, almost without qualification that where the poet does not borrow his dramatic material from the *Hystorie*, but finds it elsewhere or invents it for himself—in such parts of the play he owes nothing to it in verbal expression; there are long scenes in the tragedy without a single correspondence with the *Hystorie of Hamblet*.¹ Another point, of subordinate

¹ Act I. Sc. 3; Act II. Sc. 1; Act III. Sc. 3; Act IV. Sc. 1, 2, 4, 5, 6, 7; Act V. Sc. 1

importance but not without an interest of its own, is that we have not found in the *First Quarto* a correspondence with the *Hystorie* that deserves to be ranked alone, as having no passage related to it in the current text. Our correspondences seem naturally to go in pairs, and whenever one is single it is the *First Quarto* that fails to provide us with what we may call the twin passage. And this repeated failure on the part of the *First Quarto* makes it increasingly difficult to regard it as the first short draft of a play afterwards revised and enlarged by the poet. That mechanical additions could have been made to it is, of course, easy enough to believe—if we could believe that Shakespeare's genius ever worked in any such mechanical fashion. But how are we to conceive of him as introducing into the warp and woof of his revised tragedy this new material drawn from the *Hystorie of Hamblet*—material which he had neglected to use in his first study of the play? Did the poet send Hamlet to instant death at the hands of the King of England, and then, on after reflection, considering that such a command needed something like a threat to enforce obedience, did he insert in his revised edition the allusion to the wounds of England, “still raw and red after the Danish Sword”—an allusion based upon the three raids of plundering and massacring Danes referred to in the *Hystorie*; or did he bring Hamlet back from his voyage to England without in any way accounting for his mysterious escape, and then in his revised edition insert the episode of the pirate ship, remembering that pirates “scoured the seas and havens of the North,” the father of Hamlet being “the most renowned pirate” of them all? Do not examples such as these bring us face to face with a forest of difficulties? The amount of patching and faking in the *First Quarto* must, on any theory of its origin, be very great—has any one ever tried to estimate it? But what are we to say of the patching and faking (in this case, of course, the prerogative of genius) that must have been necessary if Shakespeare's *Hamlet* be thought of as a revision of the *First Quarto*, or even of the text the *First Quarto* is supposed to represent—has any one ever tried to estimate that? What a relief, then, it would be to our minds, if we could produce good reasons for believing that the patching and faking is confined to the *First Quarto*, and that the full text of *Hamlet* was already in existence when the pirated edition was printed! Then we could rest in the belief that Shakespeare's masterpiece was produced not piece-

meal but as a whole, when the poet's mind was pregnant with one great conception, and that his hero was born of one great impulse and effort of imaginative genius. And with regard to the problem of the *First Quarto*, may it not turn out, in spite of all that has been said to the contrary, that the way of least resistance for criticism to take is to conclude that the literary pirates did their best to steal the whole play; that they stole as much as they could obtain; and that they were compelled to patch and fake to hide their deficiencies? To support such a conclusion we can do nothing more in the meantime than mention the fact that the *First Quarto*, with all its deficiencies, would seem to rest upon a more catholic basis than either the *Second Quarto* or the *First Folio*; for as a text it shows familiarity with five different passages given in the former and omitted in the latter, and is familiar with the same number of passages given in the latter and omitted in the former: this fact of course does not favour the idea that it is an early sketch of the drama.¹ We are tempted to add that the *First Quarto* does not contain one genuine saying of Hamlet that we miss in "the true and perfect copy" of the play; and this, whatever it may mean, does not seem to imply that the poet was dissatisfied with his early work, even when that work is measured by such a standard as is furnished by the originality and genius of Hamlet himself.

It is surely not unreasonable to hope that the correspondences we have noted and collected may in their combined significance make their own impression on the mind of every candid student. Few will care to challenge the assertion that they can mean but one thing; that they bear witness to Shakespeare's familiarity with the *Hystorie* and cannot easily be thought to mean anything else. If, for instance, it were to be suggested that this familiarity need not be Shakespeare's at all, but might have been acquired by the author of the old play on which he is supposed to be working as one of his dramatic sources, the suggestion could hardly be treated with respect. It would, for one thing, transfer Shakespeare's wonderful grasp and retentiveness of memory—shall we say to Kyd—thereby transforming Shakespeare's feat into a remembering

¹ For stage purposes, the *Second Quarto* and *First Folio* were probably "cut," each in its own way: is not the *First Quarto* based on a text that existed before this "cutting" took place?

of what Kyd had remembered. But while passing at once from such a suggestion, it may not be useless or uninteresting to say a word or two of the attempt by Elze and Furness to prove that the tragedy was written before the *Hystorie*. In their contention they do not seem able to adduce much in the way of argument that need disturb us in the conclusion we have reached. Elze has been misled by his fondness for the theory that the prose version of a story should follow and not precede the dramatised version in the literature of any country where both forms are discovered to exist. For in this particular case we can afford to grant him his theory and help him to prove it, while holding to our own view of the connection between the *Hystorie* and tragedy. Does not Kyd's *Hamlet* supply the drama that Elze demands before he will allow the *Hystorie of Hamblet* to be born? And surely, when referring for the last time to the fact that no copy of the *Hystorie* is known prior to the edition of 1608, we are entitled to say that in the face of our correspondences it seems of as little weight as an *alibi* urged in defence of a criminal if excellent proof is forthcoming that he was on the spot when the crime was committed. Nor is it necessary to complicate the case or weaken the force of the evidence for the poet's indebtedness to the *Hystorie* by admitting the possibility that the details of the arras and the rat, of which so much has been made by Elze and others, were taken by the translator from the play instead of by the dramatist from the *Hystorie*. On the contrary, we shall show good cause for thinking that Shakespeare, who, as we have seen, was indebted to the translation for so many things both great and small, was indebted to it for these particulars also. And, indeed, on looking carefully into the matter, one feels inclined to believe that it has been treated with some lack of discrimination by those who have dealt with it. For, to begin with, they seem to have been mistaken in treating the two details as if there was any necessary connection between them; as if the translator must have been influenced by one and the same motive in each of these two divergences from Belleforest. Looking at them separately, then, as we are convinced it is best to do, let us ask why the writer of the *Hystorie* omitted to mention the "quilt or lodier" under which, according to the French version, the spy was discovered and killed; why did he make him hide behind the curtains instead of beneath a quilt? The suggestion that he did so under the influence of Shakespeare's

play has little to recommend it, even if we were to grant—as of course we refuse to do—that the play was prior to the *Hystorie*. For Shakespeare in describing the death of Polonius does not mention curtains of any kind in the text; and the word “arras,” which is mentioned twice in a stage direction, is not the same word as that employed by the translator. The writer of the *Hystorie* knows the word “arras” and uses it elsewhere; but in describing the death of the spy he uses his own favourite term for curtains, which is “hangings”—a term that is hardly in Shakespeare’s vocabulary. But if he did not copy the word “hangings” from Shakespeare, why did he use it at all; why did he depart from the “quilt” of Belleforest? We can only guess at a reason; but it may have been that just as Belleforest changed the “stramentum” of Saxo Grammaticus into the French “lodier,” perhaps to make the scene more intelligible or more dignified to his modern readers, for similar reasons the English translator turned “lodier” into “hangings”—unless, indeed, we may surmise that the archaic word “lodier” was already in Shakespeare’s day too hard a nut to crack, and that the translator unable to get at its meaning was forced to let it alone.

The other detail—“a rat! a rat!” stands at another level, and is of much greater interest. This cry is added by the translator of the *Hystorie* to the sentence where Hamlet is also described as crowing like a cock; it is in fact a ridiculous superfluity. It is probable, therefore, that he had some definite reason for risking such an addition; and the suggestion that the phrase had become a catch-word familiar to every frequenter of the theatre seems sufficient to explain the insertion. But when we come to ask how the catch-word was first made familiar, it seems far more natural to connect it with the *Hamlet* of Kyd than with the tragedy of Shakespeare. For it seems hard to believe that the memorable line:

How now! a rat? dead for a ducat, dead!

could have degenerated, even as a street cry, into anything so tame as “a rat, a rat.” If, then, we were forced to say whether it is more likely that Shakespeare found the phrase in the translation and made his own out of it to place it in the lips of his romantic hero, or that Hamlet’s cry should have been replaced even in the poet’s day by so vile a parody, we should not take long to decide. But we have evidence to adduce that will save us from any dis-

cussion of mere probabilities. It seems to have escaped notice that in this connection we have two passages to consider. The vulgar reduplicated cry is to be found in Shakespeare as well as the more dignified form ; only, however, in a secondary situation, only when the original episode is reported by the mother of Hamlet in a later scene. In describing the death of Polonius she says :—

Behind the arras, *hearing something stir*,
Whips out his rapier, *cries a rat, a rat. . . .*

With this let us now compare the passage from the *Hystorie* : “Whereby, *feeling something stirring* under them, *he cried ‘a rat, a rat ;’*” and at a glance we see that the one passage is copied from the other. And have we any difficulty in saying which is the original, and in deciding at the same time by this final example the whole question of Shakespeare’s indebtedness to the *Hystorie*—the question this article was meant to discuss? Can we believe that in this single passage the translator was copying from Shakespeare’s text, reversing their otherwise invariable relations? Are we to think that, following the popular taste, he preferred to take Hamlet’s cry at second hand and in this feeble form from the Queen’s lips rather than direct from the hero himself? Can we entertain a doubt that in writing these lines the dramatist as usual had the *Hystorie* lying before him, or at least in his mind’s eye, and that although, when Hamlet gives vent to the cry, Shakespeare was forced to improve upon the vulgar form, yet he found the latter good enough for the Queen in her rehearsal of the incident?

We have thus tried to establish the fact and to place it beyond a doubt that the dramatist found all he knew or needed to know of the *Hamlet* story, not directly in Belleforest, but in the translation made from it ; and we have discovered that his knowledge of the *Hystorie of Hamblet* is so thorough and minute that its phraseology has been freely employed to give tone and colour to many of the most famous passages in his masterpiece. Such a result, making the French version practically unnecessary, might well have tempted us to conclude that Shakespeare knew nothing of it, and never used it at all. And in general, the text of Belleforest gives little support to the supposition that the poet was acquainted with it. For no matter whether the language of the translation is, as is almost always the case, a slavishly literal rendering of the French, or whether, as at times, it is carelessly

independent and emphatically English in idiom, it is the *translation*, we are persuaded, that clings to the poet's memory and not the original text. In the latter case, of course—where the idiom is English—there is no room for doubt, and striking illustrations are not hard to find, but let one in the meantime suffice. “Les hommes accorts et qui avoyent le nez long” is translated in the *Hystorie* by “men of quick spirit and such as had a deeper reach.” When, therefore, Shakespeare allows Polonius to rank himself with “men of wisdom and of reach,” we can tell where he found the phrase, though we can only guess how the French idiom, had it come in his way, would have tickled his fancy, and what use he might have been tempted to make of it. It must further be noted that some of the correspondences discovered prove to be connected with passages in the *Hystorie* which have no equivalent in Belleforest, and are plainly interpolations made by the translator, who takes not infrequent liberties with the French text both in the way of addition and of omission. Of these passages we now give one example. With an exemplary zeal for morality, he thinks fit to interpolate in such a story a warning against the passion of revenge, as unbecoming to his Christian readers whom he admonishes against cherishing “a bitter gall.” And so when Hamlet is made to say that “he lacks gall to make oppression bitter,” we know, as before, where the poet found the phrase, and that he could not possibly have found it in Belleforest.

But while we may thus be reasonably confident that it is to the *Hystorie of Hamlet* Shakespeare is indebted for his intimate acquaintance with the details of the ancient story, it has to be added that there is what may be deemed satisfactory evidence of his having some acquaintance with the French version also, which though it has left no mark of its influence on the framework of the play, seems to have added a few notable words to its vocabulary. The only expression from Belleforest made use of by the dramatist in the very passage of the tragedy where we are able to hail it as appearing in its proper context, is the word “packet,” (ayant visité le paquet), to be found in Hamlet's speech to Horatio where it stands for the king's letter or commission; and it may be remarked in passing that it is the vulgar and prodigal repetition of this precious word in the course of the conversation between the Queen and Horatio—one of the greatest novelties of the *First Quarto*—which crowns the evidence that the whole of the curious

passage is corrupt. But other words evidently borrowed from the French are "salary," in the phrase "hire and salary" ("salaire" occurs four times in Belleforest, but never in the translation) and "cautel," in the phrase "no soil or cautel" ("cauteleux" is very common in Belleforest and "cautelle" occurs once, but neither is used in the translation). Perhaps the word "defeat," twice used by Shakespeare in the sense of ruin or ruinous attack, may be added, though it occurs also in other plays than *Hamlet*. Finally, two passages from the Argument of "*L'Histoire Troisième*" must be mentioned as affording a probable foundation for lines in "the great soliloquy" that are familiar to all:—"Et toutesfois les hommes achètent une telle misere et vie calamiteuse au prix de leurs ames"; and "craindre à tous propos et de mesme se voir exposé à mille occasions de crainte."

In connection with this discussion as a whole, and in view of any renewed attention it may draw to that translation which we are inclined to regard as the only certain and accessible source of the *Hamlet* tragedy, may it be permitted to suggest that the time has come when reprints both of the *Hystorie of Hamblet* and *L'Histoire Troisième* of Belleforest would seem to be demanded in the interests of all lovers of the play? Might not some enterprising publisher be persuaded to print these two in one volume and to include along with them a reprint of the *First Quarto Edition*? How often would students of *Hamlet* welcome an opportunity of comparing these closely related documents, which so few at the present day are privileged to do, or only at the expense of much time and trouble? A reprint of the old story in French would seem to be necessary in order to enable students to use the *Hystorie* with perfect confidence. The translation by itself may lead the unwary far astray. Who, without the opportunity of consulting Belleforest, could make anything of such an expression as that in Hamlet's speech to the mob after Fengon's death where he is made to say "Make ready the *nosegay* for the usurping King"? It is only by access to the French text that we discover "Dressez le bucher" in the original, and find that the translator has turned a funeral pile into a bouquet of flowers! The moral we wish to draw, however, may be enforced by a mistake made by the late Mr Widgery in his very able and ingenious essay on the *First Quarto* and repeated by Mr Joseph Allen in his articles on the "*Lost Hamlet of Kyd*" in the

Westminster Review, 1908. The word “*babler*,” misspelled “*babbler*” by the last of these two writers, is thought to denote a court fool in the service of the King of England, who is suggested by Mr Allen as the prototype of Osric and of Yorick as well. But the fact is that “*babler*” in the *Hystorie* is a misprint for “*baker*,” as the context might easily have led one to surmise. The real “*boulanger*” is to be got, of course, in Belleforest, and has nothing comical about him, though there is something rather peculiar in the flavour of his bread.

In concluding this discussion, readers may be reminded that the tabulated list of extracts is meant to serve a double purpose—it is meant to prove Shakespeare’s familiarity with the *Hystorie of Hamblet* and to establish its claim to be that form of the ancient story on which his great tragedy was founded ; but it is also meant to support the view advocated by Mommsen and Grant White that the *First Quarto* is nothing but a badly reported edition of Shakespeare’s play ; and it is hoped that if some of the extracts should seem of doubtful validity in the one direction they may be accepted as of some service in the other. It should also be noted that while the passages selected from the *Hystorie* are those that seem most impressive and convincing, yet the list is not exhaustive in itself nor does it measure the poet’s full indebtedness to the ancient chronicle. For it must not be forgotten that, in addition to the general framework of the tragedy, he owes to the *Hystorie* much of dramatic colour and detail that cannot be indicated by direct quotation. And above all, has he not borrowed from it the conception of that great gift of genius by which he has distinguished Hamlet from all other heroes ? Those, therefore, who would penetrate to the central meaning of the play, may be invited to ask themselves the question why did Shakespeare confer upon the hero of his tragedy the intellectual endowment of the hero of the legend ? Was it because a career of unbroken success, made easy in the one case by superior cleverness and cunning, provoked him to try what kind of a career he could shape for a hero who should be gifted beyond all comparison but who should never have even a chance to succeed and who should be exhibited only as a glorified failure ? If this, or something like this, was his intention, how far from the mark are all those who insist so fiercely on Hamlet’s failure as to miss the halo with which the poet has surrounded it ? And even to many who are willing to make some

general acknowledgment of Hamlet's genius, the hint may not be altogether superfluous that it was not bestowed upon him merely to make a disgraceful failure the more conspicuous; for the dramatic problem was how to exhibit his genius in spite of failure, and how to make his failure possible in spite of genius. If Shakespeare has solved the problem, it is for us to try to appreciate the solution.

In order to make the *Table of Extracts* somewhat more compact, no reference is made to the *First Quarto* when it does not furnish a parallel passage for comparison; and no reference is made to Belleforest except when the translation in the *Hystorie* is something more than a literal rendering of the French. The extracts from the *Hystorie* are paged from *Collier's Shakespeare's Library* (1843).

TABULATED LIST OF EXTRACTS FOR COMPARISON.

I.

Act I., Sc. 1, l. 84.	Dared to the combat; which had return'd To the inheritance of Fortinbras, Had he been vanquisher.
<i>First Quarto.</i>	Dared to the combate.
<i>Hystorie</i> , p. 132.	The combat was by him accepted with conditions that he which should be vanquished should lose all the riches he had in his ship, and that the vanquisher should cause the body of the vanquished to be honourably buried.
Belleforest.	Vanquisher = vainqueur.

2.

Act I., Sc. 2, l. 152.	My father's brother, but no more like my father Than I to Hercules.
<i>First Quarto.</i>	My father's brother, but no more like My father then I to Hercules.
<i>Hystorie</i> , p. 172.	In reading of this history it seemeth Hamlet should resemble another Hercules.

3.

Act I., Sc. 4, l. 14.	But to my mind, though I am native here And to the manner born, it is a custom More honour'd in the breach than the observance.
<i>First Quarto.</i>	though I am Native here and to the maner borne, It is a custome more honour'd in the breach Then in the observance.
<i>Hystorie</i> , p. 155.	Hamlet, brought up in these abuses according to the manner of his country.
Belleforest.	Institué en ces follies suivant la coustume de son país.

4.

Act I., Sc. 4, l. 17. This heavy-headed revel east and west
 Makes us traduced and tax'd of other nations :
 They clepe us drunkards, and with swinish phrase
 Soil our addition.

Hystorie, p. 160. Overcome with the fire of over great drinking, a vice
 common and familiar among the Almaines and
 other nations inhabiting the north parts of the
 world . . . filled with wine, lying like
 hogs upon the ground.

Belleforest. Other nations=toutes ces nations et peuples.

5.

Act I., Sc. 4, l. 23.

these men,
Carrying, I say, the stamp of one defect, . . .
Their virtues else—be they as pure as grace, . . .
Shall in the general censure take corruption
From that particular fault.

Hystoric, p. 180.

And in all his honourable actions made himself
worthy of perpetual memory, if one only spot had
not blemished and darkened a good part of his
praises.

6.

Act I., Sc. 5, l. 7.	Speak ; I am bound to hear.
	So art thou to revenge, when thou shalt hear.
<i>Hystoric</i> , p. 161.	The obligation that bound me to pursue his vengeance.
Belleforest.	Cette obligation qui m'estraignoit.

- Hystorie*, p. 138. Often made such and so fit answers that a wise man
would soon have judged he concealed a sharp and
pregnant spirit.
- Belleforest. Qu'il celoit un grand lustre de bon esprit.

12.

- Act II., Sc. 2, l. 605. and ack gall
To make oppression bitter.
- First Quarto*. Sure I should take it, or else I have no gall.
- Hystorie*, p. 138. Who by no means ought to have a bitter gall or
desires infected with revenge.
- Belleforest. *Not in the French—an interpolation by the trans-
lator.*

13.

- Act II., Sc. 2, l. 27. The spirit that I have seen
May be the devil, and the devil hath power
To assume a pleasing shape; yea and perhaps
Out of my weakness and my melancholy . . .
Abuses me to damn me.
- First Quarto*. This spirit that I have seen may be the divell,
And out of my weakenesse and my melancholy . . .
Doth seeke to damn me.
- Hystorie*, p. 154. (a) That devilish art (magic) whereby the wicked spirit
abuseth mankind.
- p. 154. (b) This prince by reason of his over-great melancholy.

14.

- Act III., Sc. 1, l. 1. And can you by no drift of circumstance
Get from him why he puts on this confusion?
- First Quarto*. Lordes can you by no meanes finde
The cause of our sonne Hamlet's lunacy?
- Hystorie*, p. 140. Fencion's practice took no effect, but for all that he
left not off still seeking by all means to find out
Hamlet's subtlety.
- Belleforest. *An interpolation by the translator.*

15.

Act III., Sc. 1 l. 76.

Who would fardels bear?

To grunt and sweat under a weary life . . .
Thus conscience does make cowards of us all;
And enterprises of great pitch and moment
With this regard, their currents turn awry,
And lose the name of action.

First Quarto.

To grunte and sweate under this weary life. . .
I that, O this conscience makes cowards of us all.

Hystorie, p. 149.

For why should men desire to live, when shame and
infamy are the executioners that torment their
consciences, and villany is the cause that with-
holdeth the heart from valiant enterprise, and
diverteth the mind from honest desires of glory and
commendation which endureth for ever?

16.

Act III., Sc. 1, l. 147.

O heavenly powers restore him.

First Quarto.

Pray God restore him.

Hystorie, p. 159.

But rather hoped God would restore him to his
senses again.

Belleforest.

Que les Dieux luy rendroyent son bon sens.

17.

Act III., Sc. 2, l. 63.

That no revenue hast but thy good spirits.

First Quarto.

That nothing hast but thy good minde.

Hystorie, p. 152.

Lords of small revenue.

Belleforest.

Seigneurs de peu de consequence.

18.

Act III., Sc. 2. l. 185.

And thou shalt live in this fair world behind,
Honour'd, beloved.

Hystorie, p. 135.

This princess, who at the first for her rare virtues and
courtesies was honoured of all men and beloved
of her husband.

19.

Act III., Sc. 2, l. 186.

and haply one as kind
For husband shalt thou —

First Quarto.

When ended is my date,
Thou mayst perchance have a more noble mate,
More wise, more youthful, and one —

Hystorie, p. 179. This King (besotted on his wife) . . . was desirous . . . to find her a husband that should love her (he being dead) as well as ever he did.

20.

Act III., Sc. 2, l. 189. In second husband let me be accurst !
None wed the second but who kill'd the first.

First Quarto. O speake no more, for then I am accurst ;
None weds the second but she kills the first.

Hystorie, p. 179. That woman is accursed that fears to accompany her husband to the death.

Belleforest. La femme estoit malheureuse.

21.

Act III., Sc. 2, l. 197. But what we do determine oft we break.

Purpose is but the slave to memory . . .
Grief joys, joy grieves on slender accident.
But what we doe determine oft we break.

First Quarto.

Hystorie, p. 180. For as a woman is ready to promise, so is she heavy and slow to perform and effect that which she hath promised, taking pleasure in diversity and change of new things, which as soon she doth forget and grow weary of.

22.

Act III., Sc. 2, l. 213. nor 'tis not strange
That even our loves should with our fortunes change.

Hystorie, p. 179. No promise of a woman but a very small discommodity of fortune mollifieth and altereth the same.

23.

Act III., Sc. 2, l. 221. Our wills and fates do so contrary run,
That our devices still are overthrown,
Our thoughts are ours, their ends none of our own.

First Quarto. For our demises stil are overthrown,
Our thoughts are ours, their ends none of our own.

Hystorie, p. 147. (a) Fortune so much pursueth and contrarieth our ease and welfare.

p. 167. (b) Should clean have overthrown the device.

Belleforest. Overthrown the device=gaster le dessein.

24.

- Act III., Sc. 2, l. 252. 'Tis a knavish piece of work.
First Quarto. Father, it is a knavish peece a worke.
Hystorie, p. 167. It is I alone that have done this piece of work.
 Belleforest. This piece of work = l'oeuvre.

25.

- Act III., Sc. 3, l. 28. Behind the arras I'll convey myself.
First Quarto. I'll shrowde myself behind the arras.
Hystorie, p. 142. And there hid himself behind the arras.
 Belleforest. Se cacha sous quelque loudier.

26.

- Act III., Sc. 4, l. 9. Hamlet, thou hast thy father much offended.
 Mother, you have my father much offended.
Hystorie, p. 158. Hamlet made as though he had been much offended.
 Belleforest. Feignit d'en estre fort marry.

27.

- Act III., Sc. 4, l. 23. How now ! a rat ? Dead for a ducat, dead !
 (Makes a pass through the arras).
First Quarto. I a rat, dead for a Duckat.
Hystorie, p. 142. He cried a rat, a rat ! and presently drawing his
 sword thrust it into the hangings.
 Belleforest. *An interpolation by the translator.*

28.

- Act III., Sc. 4, l. 30. *Queen*—As kill a King !
Hamlet— Ay, lady ! 'twas my word.
First Quarto. (a) But as I have a soule, I sweare by heaven,
 I never knew of this most horride murder.
 (b) Hamlet, I vow by that majestie
 That knowes our thoughts and lookes into our
 hearts.
Hystorie, p. 147. Swearing unto thee by the majestie of the gods that
 if it had lain in my power I would surely have
 saved the life of my lord and husband.

33.

Act III., Sc. 4, l. 97.	No more, sweet Hamlet.
<i>First Quarto.</i>	Sweet Hamlet, cease.
<i>Hystorie</i> , p. 147.	Nevertheless mine own sweet son.
Belleforest.	Mon fils et doux amy.

34.

Act III., Sc. 4, l. 112.	But look, amazement on thy mother sits.
<i>First Quarto.</i>	Thy mother's fearefull and she stands amazde.
<i>Hystorie</i> , p. 147.	As being ravished into some deep contemplation and as it were wholly amazed.
Belleforest.	Saisie de quelque estonnement.

35.

Act III., Sc. 4, l. 145.	Lay not that flattering unction to your soul, That not your trespass but my madness speaks.
<i>First Quarto.</i>	Idle, no mother, my pulse doth beat like yours ; It is not madness that possesseth Hamlet.
<i>Hystorie</i> , p. 146.	Weep not to see my folly but rather sigh and lament your own offence.

36.

Act III., Sc. 4, l. 175.	That I must be their scourge and minister.
<i>Hystorie</i> , p. 170.	Hamlet, the minister and executor of just vengeance.

37.

Act III., Sc. 4, l. 199.	I must to England, you know that ?
	Alack, I had forgot : 'tis so concluded on.
<i>Hystorie</i> , p. 151.	Hamlet, understanding that he should be sent into England, presently doubted the occasion of his voyage, and for that cause speaking to the Queen, desired her not to make any show of sorrow.

38.

Act III., Sc. 4, l. 201.	There's letters seal'd : and my two schoolfellows, Whom I will trust as I will adders fang'd, They bear the mandate ; they must sweep my way. And marshal me to knavery.
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Hystorie, p. 152. Having known the wicked and villainous minds o.
the two courtiers that led him to the slaughter.

39.

Act III., Sc. 4, l. 206. For 'tis the sport to have the engineer
Hoist with his own petar.
Hystorie, p. 158. Hamlet although the sport pleased him well.
Belleforest. The sport = le 'eu.

40.

Act III., Sc. 4, l. 209. O, 'tis most sweet
When in one line two crafts directly meet.
Hystorie, p. 146. He that hath to do with a wicked, cruel, and dis-
courteous man, must use craft and politic inven-
tions, such as a fine wit can best imagine.
Belleforest On use des plus gentiles inventions et forbes.

41.

Act III., Sc. 4, l. 213. Indeed this counsellor
Is now most still, most secret, and most grave.
Hystorie, p. 142. Pulled the counsellor half-dead out by the heels.
Belleforest. The counsellor = le galant.

42.

Act IV., Sc. 3, l. 12. Where the dead body is bestowed, my lord,
We cannot get from him
Now Hamlet, where's Polonius?
Not where he eats, but where he is eaten.
First Quarto. My lord, we can by no means
Know of him where the body is.
Now, sonne Hamlet, where is this dead body?
Hystorie, p. 150. Fengon was abashed to hear neither news nor tidings
of him, and for that cause asked Hamlet what was
become of him, naming the man. The prince
answered that the counsellor he sought was gone
down where the hogs meeting him, etc.

43.

Act IV., Sc. 4, l. 53. Rightly to be great
Is not to stir without great argument,
But greatly to find quarrel in a straw
When honour's at the stake.

Hystorie, p. 178. Hamlet, like a good and wise prince, sought by all means to avoid that war ; but again refusing it, he perceived a great spot and blemish in his honour, and accepting the same, he knew it would be the end of his days.

44.

Act IV., Sc. 6, l. 14. Ere we were two days old at sea.
Hystorie, p. 152. But the subtle Danish prince (being at sea).
 Belleforest. Being at sea. *An interpolation by the translator.*

45.

Act V., Sc. 1, l. 280. This is I,
 Hamlet the Dane.
First Quarto. Behold 'tis I, Hamlet the Dane.
Hystorie, p. 173. The subtleties of the Dane.

46.

Act V., Sc. 2, l. 4. Sir, in my heart there was a kind of fighting
 That would not let me sleep.
Hystorie, p. 152. Whilst his companions slept, having read the letters.

47.

Act V., Sc. 2, l. 15. Finger'd their packet . . .
 Devised a new commission, wrote it fair . . .
 That, on the view and knowing of these contents . . .
 He should the bearers put to sudden death.
First Quarto. He found the Packet sent to the King of England,
 Wherein he saw himself betrayed to death . . .
 And in the Packet there writ down that doom
 To be performed on them poynted for him.
Hystorie, p. 152. Rased out the letters that concerned his death, and
 graved others with commission to the King of
 England to hang his two companions and to turn
 the death they had devised upon their own necks ;
 wrote further, etc.
 Belleforest Tandis que ses compagnons dormoyent, ayant visité
 le paquet, grava et cisa un commandement à
 l'Anglois.

48.

Act V., Sc. 2, l. 373.	Where is this sight? What is it you would see?
	If aught of woe or wonder, cease your search.
<i>First Quarto.</i>	If aught of woe or wonder you'd behold, Then look upon this tragic spectacle.
<i>Hystorie</i> p. 164.	Let him not be moved nor think it strange to behold the confused, hideous, and fearful spectacle of the present calamity.
Belleforest.	To behold the spectacle = Voyant la face.

49.

Act V., Sc. 2, l. 400.	I have some rights of memory in this kingdom.
<i>First Quarto.</i>	I have some rights of memory to this kingdom.
<i>Hystorie</i> , pl. 170.	I am lawful successor in the kingdom.

RULES GOVERNING THE COMPETITION FOR THE
GRAHAM MEDAL.

1. The competition for the Graham Medal shall be under the authority and control of the Council of the Royal Philosophical Society of Glasgow, whose decision on all matters connected therewith shall be final.

2. Each candidate shall forward to the Secretary of the Royal Philosophical Society of Glasgow, 207 Bath Street, Glasgow, on or before 14th March of the year in which the competition is held, a paper giving an account of an unpublished original research conducted by himself in any branch of chemical science, pure or applied.

3. The award shall be made to the candidate whose research, in the opinion of the Council, or of the person or persons whom they may appoint to adjudicate in the matter, is of the highest merit, and most likely to aid in the advancement of chemical science.

4. The value of the award shall be £10, and, according to the wish of the successful candidate, may take the form of (i) the Graham Medal in gold; (ii) the Graham Medal in bronze, and scientific instruments or books; (iii) the Graham Medal in bronze, and the balance in money to be applied in chemical research.

5. The paper, on account of which the medal is awarded, shall be read before the Royal Philosophical Society of Glasgow, and shall thereafter be published in the *Proceedings* of the Society.

6. No award shall be made if, in the opinion of the Council, no paper of sufficient merit has been offered.

MINUTES OF SESSION.

1908-1909.

4th November, 1908.

THE First Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 4th November, 1908. The President, Dr Freeland Fergus, occupied the chair.

1. The President made appropriate reference to the death of the late Lord Blythswood.

2. The New Members elected at the Meeting on 29th April, were duly admitted.

3. Dr Freeland Fergus, President of the Society, delivered an address on "The Present Position and Prospects of the Royal Philosophical Society," and afterwards read a paper, entitled "Bishop Berkeley and His New Theory of Vision." A vote of thanks was accorded to Dr Fergus on the motion of Professor Magnus Maclean.

4. Mr Charles R. Gibson read a paper, illustrated by experiments, entitled "An Occasional Peculiarity in my own Colour Vision." Dr Henry J. Watt, Professor Andrew Gray, Professor John Glaister, Dr Fergus and Mr Gibson took part in the discussion which followed. A vote of thanks was passed to the Reader on the motion of the Chairman.

5. The Chairman announced that the following gentlemen had been unanimously elected to Membership of the Society:—

1. Mr WILFRED E. AGAR, M.A., 1 Eton Gardens, Hillhead,
Recommended by Professor J. Graham Kerr, Professor F. O. Bower, and Dr Freeland Fergus.

2. Mr ROBERT S. ALLAN, 15 Woodside Terrace, Glasgow. Recommended by Mr Chas. R. Gibson, Mr R. G. Service, and Dr Freeland Fergus.
3. Mr W. BOYD ANDERSON, 137 St Vincent Street. Recommended by Mr H. A. MAVOR, Dr Freeland Fergus, and Professor Peter Bennett.
4. Mr ALEC LYLE CARLAW, 14 Fitzroy Place. Recommended by Mr Jno. F. Campbell, Mr Daniel Murray, and Mr J. M'Kellar.
5. Mr GEO. H. CLARK, M.B.; Ch.B., D.P.H., 15 Clarence Drive. Recommended by Mr Chas R. Gibson, Dr William Snodgrass, and Dr Freeland Fergus.
6. Mr WALTER DENHAM, F.F.A., F.I.A., 2 Kelvinside Terrace, N., Glasgow. Recommended by Dr Freeland Fergus, Mr John D Parker, and Mr John S. Samuel.
7. Mr JAMES DONALD, Banker, Springburn, Glasgow. Recommended by Mr James Neilson, Mr J. M'Kellar, and Mr Jno. F. Campbell.
8. Mr HENRY J. DONALDSON, B.L., 124 St Vincent Street. Recommended by Mr R. A. Burr, Dr Freeland Fergus, and Professor Peter Bennett.

REPORT OF COUNCIL FOR SESSION 1907-1908.

I. *Meetings of the Society.*—Session 1907-1908 was opened on 6th November 1907, with a lecture under the auspices of the Science Lectures Association Trust. The lecture was delivered in the St. Andrew's (Kent) Hall by Sir Edwin Ray Lankester, K.C.B., F.R.S., who chose for his subject, "Horned Beasts, etc." Members were admitted by ticket. Twelve meetings of the Society were held during the Session, at which fifteen communications were made.

II.—*The Sections of the Society.*—The Sections continue to render most valuable assistance to the Society by contributing suitable papers for the fortnightly meetings. Of the fifteen communications put before the Society nine were from one or other of the Sections. In addition to these, twenty-three papers were read at sectional meetings, making a total of thirty-eight papers read during the Session. All the Sections held meetings, but the Architectural Section, the Historical and Philological Section and the Economic Science Section were able, as in previous years, to issue printed syllabuses of work. The Council of the Economic Science Section have reported as follows, and the report (save in regard to the large number of Associates) may be taken as typical of the majority :—

"The Economic Science Section has held seven ordinary meetings during the Session, at which the attendance has varied between fifty and

two hundred. The papers read have dealt with subjects of present day economic and social interest, viz.:—‘Old Age Pensions,’ ‘Workshop Management,’ ‘Small Holdings,’ ‘The Depression in the Building Trade,’ ‘Sweating,’ ‘Tramway Finance,’ and ‘Poor Law Administration.’ The papers contributed by Mr R. C. Monro Ferguson, M.P., Mr Wm Fraser, and Mr R. H. Tawney were read at meetings of the Society as communications from the Section. The number of Associates at date (30th April, 1908) is 75. Nineteen new Associates were admitted during the Session.”

III. *The Proceedings.*—The volume of the *Proceedings* for Session 1907-1908 will be ready for issue shortly. It will contain, in addition to minutes and the usual lists, fourteen papers, nine of which were read before the Society, and five at sectional meetings. But ten of the fourteen were contributed by the Sections, so that much the greater part of the matter in the volume must be placed to their credit. The variety of subjects is considerable, and while all the papers are of great interest, some of them are valuable contributions to Science. The volume will likewise include, as an appendix, the paper on “Burgh Organisation” by Dr David Murray, which it was not found possible to print in an earlier issue.

IV. *Representatives of the Society.*—Dr John Brownlee was re-appointed to the Executive of the Millport Marine Biological Association, and appointed delegate to the Congress of the Royal Sanitary Institute. Professor J. W. Gregory was appointed delegate to the Meeting of the British Association. The following is Professor Gregory’s report of the Meeting:—

“Geological Department, University,
“Glasgow, 16th September, 1908.

“Report on the Conference of the Delegates of the Corresponding Societies of the British Association at Dublin, September, 1908.

To the Council of the Royal Philosophical Society of Glasgow.

“The Conference of Delegates held two meetings. At the first meeting, on Friday, September 3, the chairman, Prof. H. A. Miers, F.R.S., delivered his opening address in which he urged that as the large central societies are becoming more and more restricted to the most specialized technical work, and the proportion of professional members in them is steadily increasing, local scientific societies are of growing importance. He also deplored the increasing use of technical terminology in scientific literature. While recognising its necessity, he pointed out that it is rendering much scientific work unintelligible except to small groups of experts. He claimed that one of the most useful functions that can be performed by local societies is the encouragement of a habit of stating scientific results in simple language. He claimed that there are very few scientific ideas or facts which cannot be expressed in non-technical English, and if local societies would eschew technical jargon they would be more successful in kindling an interest in local problems and preventing the possible ultimate estrangement between scientific and popular thought.

"At the same meeting an appeal for sanctuaries for our native fauna and flora was read by Mrs Hobson of Belfast.

"The second meeting was held on Tuesday, September 8th, and in the absence of Professor Miers, who, having been recently appointed Principal of London University, was unable to remain in Dublin, the chair was taken by Professor Grenville Cole. Professor Carpenter, of Dublin, read a paper on 'Detailed Natural History Surveys of Restricted Areas, an important work suitable for local societies.' He illustrated his inspiring paper by an account of the valuable and interesting discoveries made during the recent biological survey of the Island of Lambay off the east coast of Ireland. The results of this survey have been recently issued in a monograph on this Island, published as part of the *Irish Naturalist*; the discovery of some startling facts and many new species and new records on Lambay shows how much there is still to be done on the natural history of the British Isles. Mr Davey, of Brighton, read a paper on 'The Re stocking of Haunts whence interesting species of Animals and Plants have disappeared,' and Mr F. A. Bellamy, of Oxford, on 'Permanent Records of Natural History or other Observations by means of the Card Catalogue System.' Mr Bellamy remarked on the enormous amount of material that must have been collected by the members of local natural history societies during the past century and that has been entirely lost owing to lack of systematic records. He explained the value of the card catalogue system in recording local observations.

"The Conference adjourned to Sheffield in 1910, as there will be no Conference of Delegates at the Meeting of the Association at Winnipeg next year."

V. *Vacancies in Council.*—Sir James Fleming was appointed a Member of Council in room of Mr John A. Todd, resigned. The appointment was confirmed at the elections in April.

VI. *Graham Medal.*—A number of meetings of the Committee on the Science Lectures Trust and Graham Medal Fund were held to inquire into the causes why so few entries have been made recently for the Graham Medal Competition. The Committee prepared and submitted a report containing modified regulations for the Competition. The Report was adopted by the Council, and the revised regulations will be found in the new volume of the *Proceedings*.

VII. *The Institution of Engineers and Shipbuilders.*—The Agreement for tenancy of the Rooms by the Institution of Engineers and Shipbuilders in Scotland expired on Martinmas 1907, but a further agreement was entered into whereby the tenancy was continued till the end of August, 1908, when the Institution removed to new premises.

VIII. *Membership.*—During the session 29 ordinary members were elected and 1 was reinstated. The Membership fell considerably during the Session owing to a heavy death roll and other causes. Among the deceased members are the following:—Lord Blythwood, Lord Overtoun, Sir J. D. Marwick, Sir T. M Call Anderson, Rt. Hon. J. A. Campbell, Messrs David Stewart,

W. F. G. Anderson, James A. M'Raith, Robert M'Ewan, J. Rankine Brownlie, John Clark, Andrew Gray, William Harvie, Robert Kirk, II. P. Meares, William Shaw, W. E. Christie, J. B. Freebairn, Alex. Rose, Henry Forrester, Duncan M'Pherson, and Alex. Somerville. Six of these were Life Members. During the session three new and one old member qualified as Life Members. The Roll now includes 14 Honorary Members, 17 Corresponding Members, and 914 Ordinary Members (Life and Annual), a total of 945, against 977 a year ago.

IX. *Finance.*—The Treasurer's statement for the Session 1907-1908 shows an excess of Revenue over Expenditure of £130 17s. 4d., as against £231 12s. 2d. for Session 1906-1907, the difference arising mainly from the decrease in membership and the heavy library expenses, which are slightly compensated by the decrease in expenses of rooms. The Capital of the Society at 30th September, 1908, as shown in the Balance Sheet, was £5,350 13s. 1d., irrespective of the value of the library.

Separate statements are given by the Treasurer, as formerly, showing the position of the two funds which the Society holds in trust, viz., "The Graham Medal and Lecture Fund," and "The Science Lectures Association Fund." The balance of Revenue on these accounts for the year being £127 1s. 10d., and £6 18s. respectively.

PETER BENNETT,
Secretary.

4th November, 1908.

REPORT OF THE LIBRARY COMMITTEE.

During the past year the Library has been steadily growing, and considerable additions have been made, especially in sections which were threatening to fall out of touch with recent literature. In History, Biography, and Sociology the Library is now fairly well equipped, and negotiations are in progress for the creation of a special section in Education.

In consequence of the withdrawal of books belonging to the Institution of Engineers and Shipbuilders, a considerable amount of book space is available, and the Architectural Section have taken this opportunity of bringing their books into the main room. In the same connection arrangements are being made for the re-classification of the books in that room on the modern system of subjects, and this operation, which will occupy the whole session, will greatly enhance the usefulness of the Library, especially with respect to facilities for consultation and special research.

The list of books added by gift or purchase is appended, as is also the list of exchanges with other Societies.

JAMES KNIGHT, HON. LIBRARIAN,
Convener.

18th November, 1908.

THE Second Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 18th November, 1908. In the absence of the President Dr Eben. Duncan, Hon. Vice-President, occupied the chair.

1. The Minute of Meeting of date 4th November was approved, and was thereupon signed by the Chairman.

2. The New Members elected at the previous Meeting were duly admitted.

3. The Abstracts of Accounts for the past Session, signed by the Auditors, Mr James F. Martin and Mr David Reid; the Annual Report of Council, and the Annual Report of the Library Committee, were adopted on the motion of Dr James Knight. The thanks of the Meeting were accorded to the Auditors and to donors of books on the motion of the Chairman.

4. A Memorial Notice of the late Mr John Robertson, Hon. Librarian of the Society, prepared by Professor J. G. Robertson, M.A., B.Sc., Ph.D., was read by Dr Duncan. A vote of thanks was passed to Professor Robertson and Dr Duncan on the motion of Dr Knight.

5. Dr James Devon read a paper entitled "Some Causes of Crime," being a communication from the Sanitary and Social Economy Section. Among the speakers in the subsequent discussion were Dr Duncan, Mr Ord, Mr J. V. Stevenson, and Dr Brownlee. Dr Devon replied, and received a vote of thanks on the motion of the Chairman.

6. The Chairman announced that the following gentlemen had been unanimously elected to Membership of the Society :—

1. Mr JAMES G. MILLAR, Sheriff of Lanarkshire, 5 Lorraine Gardens. Recommended by Dr Freeland Fergus, Dr David Murray, and Dr George Neilson.
2. Rev. ROBERT WILSON, M.A., B.D., North Park, Thornliebank. Recommended by Mr John S. Samuel, Professor Magnus Maclean, Dr Freeland Fergus.

EXPENDITURE—SESSION 1907-08.

SESSION 1906-07.

ORDINARY EXPENDITURE.		1907-1908.	1906- 907.
		£ S. D.	£ S. D.
ADMINISTRATION EXPENSES—			
Remuneration to Secretary, - - -	£100 0 0		
Allowance for Treasurer's Clerks, - - -	15 0 0		
Commission to Collectors, - - -	5 11 8		
Telephone Rent, - - -	5 10 0		
Stationery, - - -	3 10 6		
Fire Insurance on Library, - - -	6 10 0		
Postages and Sundry Charges, £28 2 10			
Less Papers sold, - - -	0 12 11		
	<u>27 9 11</u>	163 12 1	160 4 6
EXPENSES OF ROOMS—			
Upkeep and Service for year, £236 5 7			
Interest on Bond, - - -	108 1 4		
	<u>344 6 11</u>		
Less Interest on Investments, - - -	16 19 5		
	<u>£327 7 6</u>		
Deduct—Rents from Institution of Engineers and other Societies, - - -			
	£278 7 6		
LIBRARY—			
New Books and Periodicals, British and Foreign, - - - - -	£144 9 0	49 0 0	87 8 9
Bookbinding, - - - - -	33 17 11		
	<u>178 6 11</u>	178 6 11	104 7 3
PRINTING—			
Printing and Postage of <i>Proceedings</i> , Circulars, etc., -		206 15 9	225 18 3
SUBSCRIPTIONS TO SOCIETIES—			
Ray Society, - - - - -	£1 1 0		
Palæontographical Society, - - - - -	1 1 0		
	<u>2 2 0</u>	2 2 0	2 2 0
EXPENSES OF SECTIONS PER SECRETARIES—			
Architectural, - - - - -	£8 16 0		
Economic Science, - - - - -	7 7 5		
Historical and Philological, - - - - -	2 17 6		
Mathematical and Physical, - - - - -	0 2 0		
	<u>19 2 11</u>	19 2 11	23 16 1
EXCESS OF ORDINARY REVENUE over Ordinary Expenditure carried down, - - - - -		56 6 4	105 12 2
	<u>£675 6 0</u>	675 6 0	711 9 0
EXTRAORDINARY EXPENDITURE.			
SURPLUS CARRIED TO CAPITAL ACCOUNT, - - - - -		130 17 4	231 12 2
	<u>130 17 4</u>	130 17 4	231 12 2

Royal Philosophical Society of Glasgow

BALANCE SHEET, AS AT 30TH SEPTEMBER, 1908.

LIABILITIES.		ASSETS.	
BOND—		BUILDINGS—	
Over Buildings at $3\frac{1}{2}\%$,	£3250 0 0	207 Bath Street—Buildings and Furnishings, per last Account,	£7933 7 4
ACCRUED CHARGES—		LIBRARY—	
Interest, Rates, &c.,	37 7 7	Not valued,	0 0 0
CAPITAL—		INVESTMENTS—	
At 30th September, 1907,	£5219 15 9	£440 Caledonian Railway Co. 4 per cent. Debenture Stock,	£492 7 4
Add Surplus per Revenue Account,	130 17 4	Glasgow Corporation, Temporary Loan,	200 0 0
	£5350 13 1		692 7 4
		CASH—	
		Clydesdale Bank, on Current Account,	£21 16 0
		Less due Hon. Treasurer,	9 10 0
			12 6 0
			£8638 0 8

GLASGOW, 26th October, 1908.—We, the Auditors appointed by the Society to examine the Honorary Treasurer's Accounts for Session 1907-08, have examined the same, and found them correct, the Balance of Cash due the Honorary Treasurer being Nine Pounds Ten Shillings.

(Signed) JAMES F. MARTIN.
DAVID REID.

JNO. MANN, C.A., *Honorary Treasurer.*

THE SCIENCE LECTURES ASSOCIATION FUND.

Dr. ABSTRACT OF TREASURER'S ACCOUNT—SESSION 1907-1908. Cr.

		Minutes of Session.	
CAPITAL AT 30th SEPTEMBER, 1907—		CAPITAL AT 30th SEPTEMBER, 1908—	
£200 Caledonian Railway Company		Investment, <i>per contra</i> , (present	
4 Per Cent. Preference Stock, in		value, £218), - - - - -	
name of the Philosophical Society,		- - - - -	
in Trust, cost, - - - - -		In Bank, on Deposit Receipt, - - -	
On Deposit Receipt, - - - - -		- - - - -	
		EXPENDITURE—	
ACCUMULATED REVENUE, 30th SEPTEMBER, 1907—		Sir Edwin Ray Lancaster, fee or Lecture given on	
Cash In Bank, - - - - -		6th November, 1907, - - - - -	
REVENUE FOR YEAR 1907-1908—		BALANCE, BEING REVENUE—	
Dividend, April 1908, less Tax, -		In Bank, on Deposit Receipt, - - -	
" Oct., - - - - -		- - - - -	
Interest from Bank, - - - - -		- - - - -	
		£296 3 0	
		£252 10 0	
		36 15 0	
		6 18 0	
		£296 3 0	

GLASGOW, 26th October, 1908.—Examined and found correct.

JNO. MANN, C.A., *Honorary Treasurer.*

(Signed) JAMES F. MARTIN.
DAVID REID.

GRAHAM MEDAL AND LECTURE FUND.

Dr. ABSTRACT OF TREASURER'S ACCOUNT, SESSION 1907-1908. *Cr.*

CAPITAL AT 30th SEPTEMBER, 1907—		CAPITAL AT 30th SEPTEMBER, 1908—	
£250 Glasgow and South-Western Railway Co. 4 Per Cent. Preference Stock in name of the Philosophical Society, in Trust, . . .	£250 0 0	Investment, <i>per contra</i> , (present value, £269), . . .	£250 0 0
Value of Die at H.M. Mint, . . .	18 18 0	Die, . . .	18 18 0
	<u>£268 18 0</u>		<u>£268 18 0</u>
ACCUMULATED REVENUE AT 30th SEPTEMBER, 1907—		BALANCE, BEING ACCUMULATED REVENUE AT 30th SEPTEMBER, 1908—	
Cash in Bank, . . .	114 13 4	£90 Caledonian Railway Co. 4 per cent. Debenture Stock, . . .	£100 14 2
REVENUE—		In Bank, on Deposit Receipt, . . .	26 7 8
Dividends from Glasgow and South-Western Railway, . . .	£9 10 0		<u>127 1 10</u>
Do. Caledonian Railway, . . .	1 14 2		<u>£395 19 10</u>
Interest from Bank, . . .	1 4 4		
	<u>12 8 6</u>		
	<u>£395 19 10</u>		

GLASGOW, 26th October, 1907.—Examined and found correct.

JNO. MANN, C.A., *Honorary Treasurer.*

(Signed) JAMES F. MARTIN,
DAVID REID.

2nd December, 1908.

THE Third Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 2nd December, 1908. In the absence of the President Mr John Mann, Jun., Vice-President, occupied the chair.

1. The Minute of Meeting of date 18th November was approved, and was thereupon signed by the Chairman.

2. The New Members elected at the previous Meeting were admitted *in absentia*.

3. Mr William Goodwin read a paper, illustrated by lantern slides and experiments, on "An Explanation of Colour-Photography." Mr Craig-Annan and Mr Chas F. Gibson made appreciative remarks on the paper, and a vote of thanks was passed to Mr Goodwin on the motion of the Chairman.

16th December, 1908.

THE Fourth Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 16th December, 1908. The President, Dr Freeland Fergus, occupied the chair.

1. The Minute of Meeting of date 2nd December was approved, and was thereupon signed by the Chairman.

2. Dr James Colville read a paper entitled, "Gleanings in the Scots Vernacular." A discussion followed in which part was taken by Mr J. T. T. Brown, Mr F. J. Amours, Mr Wm Kerr, Dr James Knight, Dr Fergus, and Dr Colville. A vote of thanks was accorded to Dr Colville on the motion of the President.

3. The following gentlemen were elected to Membership of the Society :—

1. Mr ARTHUR J. BERRY, 5 University Gardens, Glasgow. Recommended by Mr Frederick Soddy, Dr George Beilby, and Professor Archibald Barr.

2. Mr William G. K. DONALDSON, Sheriff Clerk Depute of Lanarkshire, County Buildings, Glasgow. Recommended by Dr Geo. Neilson, Dr Freeland Fergus, and Mr J. T. T. Brown.
3. Mr DAVID N. MACKAY, Writer, 173 St Vincent Street, Glasgow. Recommended by Dr Geo. Neilson, Dr Freeland Fergus, and Professor Peter Bennett.

13th January, 1909.

THE Fifth Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 13th January, 1909. The President, Dr Freeland Fergus, occupied the chair.

1. The Minute of Meeting of date 16th December was approved, and was thereupon signed by the Chairman.

2. The New Members elected at the previous Meeting were duly admitted.

3. Mr W. E. Agar, M.A., read a paper, illustrated by lantern slides, on "A Zoological Expedition to South America," being a communication from the Biological Section. Professor Graham Kerr and Professor Gregory made appreciative remarks on the paper, and a vote of thanks was passed to Mr Agar on the motion of the Chairman.

4. The following gentlemen were elected to Membership of the Society :—

1. Ex-Bailie JAMES ALEXANDER, D.L., 145 North Street, Glasgow. Recommended by Dr Geo. Neilson, Mr J. V. Stevenson, and Mr John S. Samuel.
2. Mr ANDREW MACDONALD, Sherbrooke, Pollokshields. Recommended by Mr John S. Samuel, Dr John Brownlee, and Dr Geo. Neilson.
3. Mr GEORGE WINGATE, C.A., 19 St Vincent Place, Glasgow. Recommended by Mr John Mann, Junr., Dr Freeland Fergus, and Dr Geo. Neilson.

27th January, 1909.

THE Sixth Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 27th January, 1909. The President, Dr Freeland Fergus, occupied the chair.

1. The Minute of Meeting of date 13th January was approved, and was thereupon signed by the Chairman.

2. The New Members elected at the previous Meeting were duly admitted.

3. Mr James Muirhead read a paper entitled "The Principles of Municipal Taxation," being a communication from the Economic Science Section. Speakers in the discussion which followed were Mr Morrison, Mr Walker, Bailie Bruce Murray, Ex-Bailie Burt, Dr Duff, Mr M'Kendrick, Councillor Whitson, Councillor Smith, Mr John Mann, Jun., Mr Boyd Anderson, Mr George Barclay, Mr Mitchell, and Dr Fergus. A vote of thanks was accorded to Mr Muirhead on the motion of the Chairman.

4. Mr Robert Fraser, Stockbroker, 55 West Regent Street, recommended by Mr George Wingate, Mr John Mann, Jun., and Dr Geo. Neilson, was elected to Membership of the Society.

10th February, 1909.

THE Seventh Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 10th February, 1909. In the absence of the President Dr William Snodgrass, Vice-President, occupied the chair.

1. The Minute of Meeting of date 27th January was approved, and was thereupon signed by the Chairman.

2. The New Member elected at the previous Meeting was admitted *in absentia*.

3. Mr Peter Macnair, F.G.S., F.R.S.E., read a paper, illustrated by lantern slides, entitled "On some types of overfolding of the

Schists in the Loch Tay District." Mr Reoch, Dr Muirhead, and Mr Stark took part in the discussion which followed, and a vote of thanks was passed to Mr Macnair on the motion of the Chairman.

4. Mr Alexander D. Ross, M.A., B.Sc., F.R.S.E., read a paper, with lantern illustrations, on "Recent Earthquakes and their Investigation," being a communication from the Mathematical and Physical Section. A discussion followed in which part was taken by Dr Muirhead, Mr Galloway, Mr Macnair, and Mr Stark; and Mr Ross received the thanks of the meeting on the motion of the Chairman.

5. The following gentlemen were elected to Membership of the Society :—

1. Mr THOMAS H. BARR, Colliery Owner, Wimborne, Kilmacolm. Recommended by Mr John Mann, Jun., Professor J. Graham Kerr, and Dr Freeland Fergus.
2. Mr ROBERT CORBET, Actuary, Barcaldine, Springkell Avenue, Maxwell Park, Glasgow. Recommended by Mr John Edwards, Dr Freeland Fergus, and Dr Oswald Fergus.

24th February, 1909.

THE Eighth Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 24th February, 1909. The President, Dr Freeland Fergus, occupied the chair.

1. The Minute of Meeting of date 10th February was approved, and was thereupon signed by the Chairman.

2. The New Members elected at the previous Meeting were duly admitted.

3. Mr R. F. Muirhead, M.A., D.Sc., read a paper on "Some Considerations on Scottish Universities with special reference to Needed Reforms." Among the speakers in the discussion which followed were Dr Hutchison, Dr Snodgrass, Dr Knox, Mr Erskine Muirhead and the Chairman. Dr Muirhead received the thanks of the meeting for his paper.

10th March, 1909.

THE Ninth Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 10th March, 1909. The President, Dr Freeland Fergus, occupied the chair.

1. The Minute of Meeting of date 24th February was approved, and was thereupon signed by the Chairman.

2. Mr John Edwards read a paper, illustrated by lime-light views, entitled, "An Old French Cathedral-City (Saint Bertrand de Comminges) and its Bishops," being a communication from the Historical and Philological Section. Dr Neilson and the President spoke in appreciative terms of the paper, and a vote of thanks was passed to Mr Edwards.

3. The following gentlemen were duly elected to Membership of the Society :—

1. Mr WILLIAM ANDERSON, J.P., 59 Kirklee Road, Kelvinside, Glasgow. Recommended by Dr Freeland Fergus, Dr Wm Snodgrass, and Principal M'Lean.
2. Mr JOHN HUTCHISON, M.A., LL.D., Rector, the High School, Elmbank Street, Glasgow. Recommended by Dr Freeland Fergus, Dr Geo. Neilson, and Mr John Clark.
3. Mr WILLIAM TODD RITCHIE, M.A., Bonniebrae, Sinclair Street, Helensburgh. Recommended by Professor Medley, Mr John Clark, and Professor Bennett.

24th March, 1909.

THE Tenth Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 24th March, 1909. The President, Dr Freeland Fergus, occupied the chair.

1. The Minute of Meeting of date 10th March was approved, and was thereupon signed by the Chairman.

2. The New Members elected at last Meeting were duly admitted.

3. Professor Richard Lodge, M.A., LL.D., read a paper, entitled "Notes on the Report of the Poor Law Commission," being a communication from the Economic Science Section. A discussion followed in which part was taken by Mr Newsom, Mr Motion, Dr M'Kechie, Dr A. K. Chalmers, Mr Jones, and Mr Bremner. A vote of thanks was accorded to Professor Lodge.

4. The following were duly elected to Membership of the Society :—

1. The Right Hon. and Rev. LORD BLYTHSWOOD, Renfrew. Recommended by Dr Freeland Fergus, Mr John Mann, and Dr George Neilson.
2. Mr ALEXANDER M'DOUGALL, M.A., B.Sc., 3 Alexandria Terrace, Govan. Recommended by Professor Magnus Maclean, Mr John Stobo, and Dr George Neilson.

7th April, 1909.

THE Eleventh Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 7th April, 1909. In the absence of the President and Vice Presidents Dr Brownlee occupied the chair by request.

1. The Minute of Meeting of date 24th March was approved, and was thereupon signed by the Chairman.

2. The New Members elected at last Meeting were duly admitted.

3. Dr Arnold Gray read a paper, illustrated by lantern slides, on "The Laws of Individual Growth," being a communication from the Sanitary and Social Economy Section. Speakers in the discussion which followed were Dr Brownlee, Dr Knight, Dr Muirhead, Mr John F. Campbell, Mr Erskine Muirhead, and Dr Albert A. Gray. Dr Arnold Gray replied and was accorded the thanks of the Meeting.

21st April, 1909.

THE Twelfth Meeting of the Society, for Session 1908-1909, was held in the Rooms, 207 Bath Street, on Wednesday, 21st April, 1909. The President, Dr Freeland Fergus, occupied the chair.

1. The Minute of Meeting of date 7th April was approved, and was thereupon signed by the Chairman.

2. The President announced that no additional nominations for the annual vacancies in the Council having been received, the nominees of the Council, duly advertised, were held to have been elected, viz. :—Vice-President, Dr George Neilson ; Members of Council—(a) for three years : The Right Rev. Bishop Campbell, D.D., Sir James Fleming, Professor A. L. Mellanby, D.Sc., Mr John S. Samuel ; (b) for one year : Mr C. H. Roemmele ; Hon. Treasurer, Mr John Mann ; Hon. Librarian, Dr James Knight ; Auditors, Mr W. R. Copland, Mr D. M'Kechnie.

3. Dr A. S. M'Gregor read a paper, illustrated with lantern slides, entitled, "An Inquiry into the Physique of Children admitted to Belvidere Fever Hospital, Glasgow, 1907-08." The paper was a communication from the Sanitary and Social Economy Section. Speakers in the discussion which followed were, Dr A. K. Chalmers, Mr Erskine Muirhead, Dr Dyer, Dr Snodgrass, Mr Roemmele, Dr Fergus.

Dr M'Gregor replied, and received the thanks of the Meeting on the motion of the Chairman.

4. This Minute was read by the Secretary and approved by the Meeting, and the Chairman authorised to sign it when it should be engrossed in the Minute Book.

OFFICE-BEARERS
OF THE
Royal Philosophical Society of Glasgow.

SESSION 1908-1909.

President.

FREELAND FERGUS, M.D., F.R.S.E., F.F.P.S.G.

Vice-Presidents.

*JOHN MANN, Jun., M.A., C.A.

WILLIAM SNODGRASS, M.A., M.B., C.M., F.F.P.S.G.

Professor J. GRAHAM KERR, M.A.

Honorary Vice-Presidents

Professor JOHN GRAY M'KENDRICK, M.D., LL.D., F.R.S., F.R.S.E.,
F.R.C.P.E.

Professor JOHN FERGUSON, M.A., LL.D., F.R.S.E., F.C.S., F.S.A.
F.S.A.(Scot.)

EBENEZER DUNCAN, M.D., F.F.P.S.G.

Professor ARCHIBALD BARR, D.Sc., M.Inst. C.E.

DAVID MURRAY, M.A., LL.D., F.S.A.

JAMES KNIGHT, M.A., D.Sc., *Hon. Librarian.*

JOHN MANN, C.A., *Hon. Treasurer.*

Professor PETER BENNETT, *Secretary.*

Presidents of Sections.

ALEXANDER GARDNER, *Architectural Section.*

J. T. T. BROWN, *Historical and Philological Section.*

J. V. STEVENSON, *Sanitary and Social Economy Section.*

THOMAS JONES, M.A., *Economic Science Section.*

R. F. MUIRHEAD, D.Sc., *Mathematical and Physical Section.*

Prof. F. O. BOWER, *Biological Section.*

Other Members of Council.

*Prof. DUDLEY J. MEDLEY, M.A.

*JOHN M'KELLAR.

*Sir JOHN STIRLING-MAXWELL, Bart.

*Sir JAMES FLEMING.

GEORGE NEILSON, LL.D.

Prof. THOMAS GRAY, D.Sc., Ph.D.

CHARLES R. GIBSON.

Principal ANGUS M'LEAN, B.Sc.

JOHN BROWNEE, D.Sc., M.D.

Prof. J. W. GREGORY, D.Sc.

JOHN INGLIS, LL.D.

FRED. G. MACKILLOP, M.A., LL.B.

* Retire by rotation in April, 1909.

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New York Public Library, 40 Lafayette Place.

New York Academy of Sciences Library, Seventy-Seventh Street, Central Park, West.

School of Mines, Columbia College. The Associate Editor.

Philadelphia—

Academy of Natural Science of Philadelphia.

The Associated Alumni of the Central High School of Philadelphia.

American Pharmaceutical Association.

UNITED STATES—*continued.*

Philadelphia—

American Philosophical Society. The Hon. Secretaries, 104 South Fifth Street.

Franklin Institute, 15 South Seventh Street.

Numismatic and Antiquarian Society of Philadelphia.

Wagner Free Institute of Science, corner of Seventeenth Street and Montgomery Avenue.

Rochester (N.Y.)—

Rochester Academy of Science. Corresponding Secretary.

St. Louis (Mo.)—

Academy of Science of St Louis, 3817 Olive Street.

Missouri Botanical Garden.

Salem—

American Association for the Advancement of Science.

San Francisco (California)—

California Academy of Sciences.

Topeka (Kansas)—

Kansas Academy of Science.

Washington—

Bureau of Education (Department of the Interior).

Bureau of Ethnology.

Smithsonian Institution.

United States Geological Survey.

United States National Museum (Department of the Interior).

United States Naval Observatory.

United States (Department of Agriculture).

Volta Bureau.

LIST OF PERIODICALS.

(Those received in exchange are indicated by an "a").

WEEKLY.

Academy.	English Mechanic.
Architect.	aIllustrated Official Journal of Abridgments of Patents.
Athenæum.	aJournal of the Society of Arts.
British Journal of Photography.	Journal of Gas Lighting.
Builder.	Lancet.
Building News.	La Nature.
Chemical News.	Nature.
Comptes Rendus.	Notes and Queries.
County and Municipal Record.	aPharmaceutical Journal.
aDeutsche Kolonialzeitung.	aPublishers' Circular.
Dingler's Polytechnisches Journal.	Science.
Electrical Review.	Scientific American and Supplement.
Electrician.	Zeitschrift für Angewandte Chemie.
aEngineering.	

FORTNIGHTLY.

Annalen der Chemie (Liebig's).	Journal de Pharmacie et de Chimie.
aBerichte der Deutschen Chemischen Gesellschaft.	Journal für Praktische Chemie.

MONTHLY.

aAmerican Chemical Journal.	Antiquary.
American Journal of Science.	Beiblätter zu den Annalen der Physik.
Analyst.	Bulletin de la Société Chimique de Paris.
Annalen der Physik.	Bulletin de la Société Géologique de France.
Annales de Chimie et de Physique.	Bulletin de la Société Industrielle de Mulhouse.
Annales de l'Institut Pasteur.	Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
Annales des Mines.	Bulletin of the American Mathematical Society.
Annales des Ponts et Chaussées.	aCanadian Entomologist.
Annales des Sciences Naturelles—Botanique.	
Annales des Sciences Naturelles—Zoologie.	
Annals and Magazine of Natural History.	

MONTHLY—continued.

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|---|---|
| <p> <i>a</i>Engineering Review.
 <i>a</i>Electrical Magazine.
 <i>a</i>Geographical Journal.
 Geological Magazine.
 <i>a</i>Johns Hopkins University Circulars.
 Journal of Botany.
 <i>a</i>Journal of the Chemical Society.
 Journal of Education.
 <i>a</i>Journal of the Franklin Institute.
 <i>a</i>Journal of the Royal Photographic Society.
 <i>a</i>Journal of the Society of Chemical Industry.
 <i>a</i>Journal of the Western Society of Engineers.
 Library Association Record.
 Library World.
 London, Edinburgh, and Dublin Philosophical Magazine.
 Petermanns Mitteilungen. </p> | <p> Polytechnic Bibliothek.
 <i>a</i>Proceedings of the Royal Society of London.
 <i>a</i>Proceedings of the Society of Biblical Archæology.
 Revue Universelle des Mines.
 <i>a</i>Royal Astronomical Society's Monthly Notices.
 Science Abstracts.
 <i>a</i>Science of Man.
 <i>a</i>Scottish Geographical Magazine.
 <i>a</i>Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin.
 <i>a</i>Tijdschrift van het Koninklijk Nederlandoch Aardrijkskundig Genootschap.
 Zoologist.
 Zeitschrift für Analytische Chemie. </p> |
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QUARTERLY.

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| <p> Annals of Botany.
 Annals of Scottish Natural History.
 <i>a</i>Archives Néerlandaises des Sciences Exactes et Naturelles.
 <i>a</i>Bulletin of the American Geographical Society.
 <i>a</i>Bulletin of the Kansas University. Economic Journal.
 Englische Studien.
 Jahrbuch über die Fortschritte der Mathematik.
 Journal of Anatomy and Physiology.
 <i>a</i>Journal of the Anthropological Institute of Great Britain.
 <i>a</i>Journal of Manchester Geographical Society.
 <i>a</i>Journal of the Royal Institute of British Architects.
 Journal of the Royal Microscopical Society.
 <i>a</i>Journal of the Royal Statistical Society.
 <i>a</i>Journal of the Scottish Meteorological Society. </p> | <p> <i>a</i>Memorias Y Revista de la Sociedad Científica "Antonio Alzate."
 Mind: a Quarterly Review of Psychology and Philosophy.
 <i>a</i>Proceedings of the American Philosophical Society.
 Quarterly Journal of Economics.
 Quarterly Journal of Geological Society.
 Quarterly Journal of Microscopical Science.
 <i>a</i>Quarterly Journal of Royal Meteorological Society.
 Quarterly Journal of Pure and Applied Mathematics.
 Reliquary and Illustrated Archæologist.
 Record of Technical and Secondary Education.
 Revue Historique.
 <i>a</i>School of Mines Quarterly.
 Scottish Historical Review.
 Scientific Roll. </p> |
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ANNUALLY.

British Journal Photographic Almanac.	Palæontographica Society's Publications.
Hazell's Annual.	Philosophical Transactions, Royal Society of London.
Jahres-Bericht Chemischen Technologie.	Ray Society's Publications.
Journal of the Royal Agricultural Society of England.	Report of the Board of Education.
Murray's English Dictionary.	Statesman's Year Book.
Journal de L'École Polytechnique.	Symons' British Rainfall.
	Wright's English Dialect Dictionary.

The LIBRARY and the READING-ROOM are open:—Winter, 9.30 a.m. till 8 p.m. (except Saturdays); Saturdays, till 2 p.m.

Summer (May till October, except during the holidays, from the 11th till 31st July), 9.30 a.m. till 5 p.m.; Saturdays, till 1 p.m.

LIST OF MEMBERS
OF THE
Royal Philosophical Society of Glasgow
FOR 1908-1909.

HONORARY MEMBERS.

(*Limited to Twenty.*)

WITH YEAR OF ELECTION.

FOREIGN.

Rudolph Albert von Kölliker, Würzburg.	1860
Professor Ernst Heinrich Hæckel, Jena.	1880
Professor Georg Quincke, Hauptstrasse 47, Friederichsbau, Heidelberg.	1890

AMERICAN AND COLONIAL.

Thomas Muir, M.A., LL.D., F.R.S.S., L. and E., Superintendent General of Education, Cape Colony.	1892
5 Archibald Byron Macallum, M.A., M.B. (Tor.), Th.D. (Johns Hopkins), Sc.D. (Yale), LL.D. (Aberd), F.R.S., University of Toronto, 59 St. George Street, Toronto, Canada,	1908

BRITISH.

Sir Joseph Dalton Hooker, C.B., G.C.S.I., M.D., D.C.L., LL.D., F.R.S., The Camp, Sunningdale.	1874
The Right Hon. Lord Rayleigh, M.A., D.C.L., LL.D., F.R.S., F.R.A.S., F.R.S.G., Hon. Prof. of Nat. Philosophy in the Royal Institution, London, Terling place, Witham, Essex.	1890
The Right Hon. Lord Lister, O.M., LL.D., D.C.L., F.R.S., 12 Park crescent, Portland place, London, W.	1895
Sir Archibald Geikie, LL.D., D.Sc., F.R.S., F.R.S.E., F.G.S., Shepherd's Down, Haslemere, Surrey,	1895
10 Professor Edward Albert Schäfer, LL.D., F.R.S., M.R.C.S., University of Edinburgh.	1902
Sir William Huggins, K.C.B., D.C.L. Oxon., LL.D. Camb, Pres. R.S., F.R.A.S., etc., 90 Upper Tulse-hill, London, S.W.	1904
Sir William Ramsay, K.C.B., LL.D., D.Sc., Ph.D., F.R.S., Professor of Chemistry, University College, London, 19 Chester Terrace, Regent's Park, London, N.W.	1904
Sir William Crookes, D.Sc., F.R.S., 7 Kensington Park Gardens, London, W.,	1908
Sir David Gill, K.C.B., LL.D., D.Sc., F.R.S., F.R.A.S., 34 De Vere Gardens, Kensington, London, W.,	1908

CORRESPONDING MEMBERS.

WITH YEAR OF ELECTION.

Sir Thomas E. Thorpe, Ph.D., F.R.S., F.R.S.E., Principal of the Government Laboratories, Clement's Inn-passage, W.C.	1874
John Aitken, LL.D., F.R.S., F.R.S.E., Ardenlea, Falkirk.	1883
Sir James Dewar, M.A., F.R.S., F.R.S.E., M.R.I., Jacksonian Professor of Physics, University of Cambridge, and Professor of Chemistry in the Royal Institution of Great Britain, 1 Scroope terrace, Cambridge.	1883
Sir Joseph W. Swan, M.A., D.Sc., F.I.C. F.C.S., M.I. Mech. E., Hon. M.I.E.E., F.R.S., Overhill, Warlingham, Surrey.	1883
5 William Milne, M.A., B.Sc., F.R.S.E., Uitenhage, Cape Colony.	1894
Richard Lodge, M.A., Professor of History in Edinburgh University.	1899
Edmund J. Mills, D.Sc., LL.D., F.R.S., Emeritus Professor of Technical Chemistry, Glasgow and West of Scotland Technical College, 64 Twyford avenue, West Acton, London, W.	1901
Arthur Schuster, Ph.D., F.R.S., Victoria park, Manchester.	1901
W. S. McCormick, M.A., LL.D., 2 St Andrew's square, Edinburgh.	1902
10 John George Bartholomew, F.R.S.E., F.R.G.S., Geographical Institute, Park road, Edinburgh.	1902
James Burgess, C.I.E., LL.D., F.R.S.E., Hon. A.R.I.B.A., F.R.G.S., 22 Seton place, Edinburgh.	1902
Frederick Emley, Literary and Philosophical Society of Newcastle-upon-Tyne.	1902
Professor Cargill G. Knott, D.Sc., F.R.S.E., 42 Upper Gray street, Edinburgh.	1902
Principal John Yule Mackay, M.D., LL.D., University College, Dundee.	1902
15 Professor John Millar Thomson, LL.D., F.R.S., F.I.C., F.C.S., King's College, and 9 Campden Hill Gardens, London, W.	1902
Professor Robert Wallace, F.R.S.E., F.L.S., F.C.S., University of Edinburgh.	1902

ORDINARY MEMBERS.

WITH YEAR OF ENTRY.

a Denotes Life Members.

Adam, Stephen, 168 Bath street.	1896	Alexander, D. M., 5 Derby crescent, Kelvinside.	1887
<i>a</i> Adam, Thomas, F.S.I., 27 Union street.	1892	Alexander, James, D.L., 145 North street.	1909
Adams, John, M.B., 1 Queen's crescent, W.	1902	<i>a</i> Allan, Henry, 2 Park gardens.	1900
Adams, William, Makerstoun, Bearsden.	1891	<i>a</i> Allan, James A., 25 Bothwell st.	1904
5 Addison, W. H., Superintendent Mount Florida Deaf and Dumb Institution.	1895	15 <i>a</i> Allan, Robert S., 15 Woodside ter.	1908
<i>a</i> Agar, Thomas F., Argentine Consul-General, 30 George square.	1896	Alston, J. Carfrae, 9 Lorraine gard.	1887
Agar, Wilfred E., M.A., 1 Eton gardens, Hillhead.	1908	Anderson, Alexander, 157 Trongate.	1869
Aiken, James, of Dalmoak, 201 West George street.	1905	<i>a</i> Anderson, Alexander, C.E., Farme Cottage, Rutherglen.	1907
Aikman, W. G., 12 Kingsborough gardens, Kelvinside.	1899	<i>a</i> Anderson, David H., Clarendon, Helensburgh.	1904
10 Aiton, Alexander Hamilton, 190 West George street.	1902	20 Anderson, James, c/o Anderson & Co., 12 Buchanan street.	1900
		Anderson, James, 168 George street.	1890
		Anderson, James Scott, Bardowie Castle, Milngavie.	1902
		Anderson, James Spencer, 84 Albert drive, Crosshill.	1901

- Anderson, John, 142 West Nile street. 1884
- 25 Anderson, J. B. Mackenzie, M.B., 8 Buckingham terrace, Hillhead. 1895
- Anderson, R. T. R., 42 Roselea drive. 1889
- Anderson, Robert, 76 Bath street. 1896
- Anderson, Robert, Eastwoodhill, Giffnock. 1900
- aAnderson, Robert Locke, 233 St Vincent street. 1901
- 30 Anderson, Wm, 12 Princes square. 1900
- aAnderson, William, 133 Wellington street. 1890
- Anderson, William, J., C.A., 149 West George street. 1906
- Anderson, William, J.P., 59 Kirklee road, Kelvinside. 1909
- Anderson, W. Boyd, 137 St Vincent street. 1908
- 35 Andrew, Grant, 12 Woodside terrace. 1900
- aAndrew, James, 160 West George street. 1900
- Angus, Robert, Ladykirk, Monkton, Ayrshire. 1901
- aAnnan, J. Craig, 518 Sauchiehall street. 1888
- Annandale, Charles, M.A., LL.D., 35 Queen Mary avenue. 1888
- 40 Arend, Waldemar, 1 Queensborough gardens. 1904
- Arnell, Allan, Stewarton drive, Cambuslang. 1901
- aArnot, J. L., 204 Bath street. 1890
- Arrol, Theodore A., Torwood Hill, Row, Dumbartonshire. 1902
- Arrol, Wm. A., Torwoodhill, Row. 1869
- 45aArrol, Sir William, LL.D., Seafield, Ayr. 1900
- aArthur, Andrew, 78 Queen street. 1902
- Arthur, Henry M., C.A., 79 West Regent street. 1908
- aArthur, James, 78 Queen street. 1900
- Arthur, Sir Matthew, Bart., 78 Queen street. 1900
- 50 Baird, Allan F., 192 St. Vincent street. 1904
- aBaird, J. G. A., M.P., Wellwood, Muirkirk. 1892
- aBalfour, Alexander, Kelvindare, Kelvinside. 1900
- Balfour, John A., F.R.Hist.S., Kelvindare, Kelvinside, Glasgow. 1907
- Ballantine, George, jun., 100 Union street. 1897
- 55 Bannatyne, Dugald, C.A., 191 West George street. 1907
- Barbour, Wm, M.B., C.M., 3 Edelweiss terrace, Partick. 1900
- Barclay, A. J. Gunion, M.A., F.R.S.E., High School. 1893
- Barclay, A. P., 133 St Vincent street. 1890
- Barclay, George, 8 Windsor circus. 1891
- 60 Barclay, James, 16 Roxburgh street, Kelvinside. 1871
- Barman, Harry D.D., 21 University gardens. 1904
- Barnet, John, 73 Robertson street. 1901
- aBarr, Archibald, D.Sc., Professor of Civil Engineering and Mechanics in the University of Glasgow, Royston, Dowanhill. 1890
- aBarr, James, C.E., I M., F.S.I., 221 West George street. 1883
- 65 Barr, Patrick, 51 Bath street. 1902
- Barr, Thos, M.D., F.F.P.S.G., 13 Woodside place, W. 1879
- aBarr, Thomas H., Wimborne, Kilmacolm. 1909
- Barrett, Francis Thornton, Mitchell Library. 1880
- Bauermeister, F., 49 Gordon street. 1901
- 70 Baxter, John, I.M., 243 St Vincent street. 1901
- Baxter, W. R., 36 Sutherland terrace. 1900
- Beardmore, W., Parkhead Forge. 1901
- Beaton, Sir George T., B.A. (Cantab.), M.D., 7 Woodside cres. 1881
- Beaumont, Frank, B.A.(Lond.), 1 Princes street, Pollokshields. 1904
- 75 Becker, L., Ph.D., Professor of Astronomy in the University of Glasgow, The Observatory. 1895
- Beckett, Charles E., M.A., LL.B., 163 St Vincent street. 1903
- Beckett, William, M.A., 225 West George street. 1900
- Beedle, Peter D. Ridge, 18 Ashton gardens. 1902
- Begg, Wm, 636 Springfield road. 1883
- 80 Beilby, George T., LL.D., F.R.S., 11 University gardens, Hillhead. 1895
- Bell, George, architect, 212 St Vincent street. 1900
- aBell, Henry, Mynthurst, Reigate, Surrey. 1876
- Bell, Sir James, Bart, 135 Buchanan street. 1877
- aBell, James T., 330 Mansfield road, Nottingham. 1896
- 85aBell, John J., Clyde Cottage, Craigen-doran. 1896
- aBennett, Professor Peter, *Secretary*, 207 Bath street. 1900
- Bennett, Robert J., Savoy park, Ayr. 1883
- Bergius, William M., 14 St. Enoch square. 1907
- aBerry, Arthur J., 5 University gdns. 1909

- 90 Berry, R. A., Professor of Chemistry,
West of Scotland Agricultural Col-
lege, 6 Blythswood square. 1906
- a Biggart, Thomas, 105 West George
street. 1900
- a Bilsland, Sir William, Bart., 28 Park
circus. 1888
- Binnie, Thomas, Junr., M.A., 3 Park
Gate. 1903
- a Birkmyre, John, Broadstone, Port-
Glasgow. 1900
- 95a Bishop, A. Henderson, Thornton
hall, Lanarkshire. 1896
- Black, J. Albert, Lagarie, Row. 1869
- Black, Malcolm, M.D., 5 Canning
place. 1880
- a Black, William Dunn, J.P., The
Manor House, Wallington, Surrey. 1901
- a Blackie, J. Alexander, 17 Stanhope
street. 1881
- 100a Blackie, J. Robertson, North Bank,
Dowanhill. 1881
- a Blackie, Walter W., B.Sc., The Hill
House, Helensburgh. 1886
- Blair, Alexander, F.S.I., 198 West
George street. 1908
- Blair, William, 24 St Vincent
place. 1902
- a Blyth, Robert, Balvonie, Skelmorlie. 1885
- 105 Blythswood, The Right Hon. and
Rev. Lord, Renfrew. 1909
- Borthwick, James D., 46 Balshagray
avenue, Partick. 1891
- a Boston, Alexander L., 12 Argyle
arcade. 1902
- Bottomley, James T., M.A., Hon.
LL.D. (Glas.), D.Sc., F.R.S.,
F.R.S.E., F.C.S., 13 University
gardens, Hillhead. 1880
- Bottomley, Wm, C.E., 15 University
gardens. 1880
- 110 Bower, F.O., D.Sc., M.A., F.R.S.,
F.L.S., Regius Professor of Botany
in the University of Glasgow,
1 St John's terrace, Hillhead. 1885
- Bowers, John, *Depute* Town Clerk,
City Chambers. 1904
- Boyd, James, Boydston, Lenzie. 1905
- Byd, John, Shettleston Iron-works,
near Glasgow. 1873
- Boyd, T. A., Shettleston iron works,
Glasgow. 1908
- 115a Boyne, James, Duncliffe, Bearsden. 1901
- a Broadfoot, William R., Inchholme
Works, Whiteinch. 1900
- Brock, Henry, Auchenhughish, Arden,
Dumbartonshire. 1905
- Brodie, William, B.L., 77 St
Vincent street. 1902
- Bromhead, Horatio K., F.R.I.B.A.,
I.A., 18 Kirklee road, Kelvinside. 1901
- 120 Brown, George Arbuckle, M.B.,
C.M., D.P.H. (Camb.), 180 Hynd-
land road, Partick. 1900
- a Brown, Hugh, 5 St John's terrace,
Hillhead. 1887
- Brown, James, 76 St Vincent street. 1876
- Brown, John Armour, Moredun,
Paisley. 1901
- Brown, J. T. T., Kessiebank,
Cambuslang. 1902
- 125a Brown, Nicol Paton, 22 Belhaven
terrace. 1901
- Brown, Richard, Writer, 165 St
Vincent street. 1895
- Brown, Robert, 19 Jamaica street. 1882
- a Brown, Wm Stevenson, 67 Washing-
ton street. 1886
- a Brown, William, 165 West George
street. 1892
- 130 Brown, Robert, B.Sc., 45 Washing-
ton street. 1893
- Brownlee, Jno., M.D., Glasgow Fever
Hospital, Belvidere. 1902
- Brownlie, John Douglas, M.B.,
Ch.B., L.D.S., 10 Brandon place. 1901
- Bruce, Alex., Clyne House, Pollok-
shields. 1901
- Bryce, Thomas H., M.A., M.D.,
Professor of Anatomy in the Uni-
versity of Glasgow, 2 Granby
terrace, W. 1908
- 135a Buchanan, Andrew, Dunfillan,
Helensburgh. 1902
- a Buchanan, A. W. G., Parkhill, Pol-
mont, Stirlingshire. 1903
- Buchanan, George Douglas, Sil-
verrae, Giffnock. 1901
- Buchanan, Peter, 7 Garthland street. 1901
- Buchanan, Robert Macneil, M.B.,
C.M., F.F.P.S.G., Corindi, Scots-
townhill. 1900
- 140a Buchanan, Wm. Enderley, Bearsden. 1886
- Burnet, John James, A.R.S.A.,
F.R.I.B.A., 70 University avenue. 1892
- Burns, J., M.D., 15 Fitzroy place,
Sauchiehall street. 1864
- a Burrell, Wm, 54 George square. 1900
- Burton, William L., 6 Richmond
crescent, Glasgow. 1899
- 145 Burr, Robert A., M.A., B.Sc., 77
Sinclair drive, Langside. 1904
- Caird, Robert, LL.D., F.R.S.E., 56
Esplanade, Greenock. 1898
- a Caldwell, George B., Scotia Leather
Works, Boden street. 1892
- Caldwell, James, 6 Newton place. 1900
- Cameron, Sir Hector C., M.D., Pro-
fessor of Clinical Surgery, Univer-
sity of Glasgow, 18 Woodside
crescent. 1873

- 150a Campbell Arch., Springfield quay. 1895
 Campbell, James Murdoch, 147 George street. 1901
 Campbell, John, 49 St Andrew's drive, Pollokshields. 1901
 a Campbell, John Ferguson, 15 Montgomerie street, North Kelvinside. 1892
 Campbell, John M., F.E.I.S., Sir John Neilson Cuthbertson School, and 14 Royal crescent, Crosshill. 1900
 155 Campbell, John MacNaught, C.E., F.Z.S., F.R.S.G.S., 6 Franklin terrace, Dumbarton road. 1883
 Campbell, Malcolm, 18 Gordon street. 1894
 Campbell, M. Pearce, 9 Lynedoch crescent. 1905
 Campbell, Joseph Dawson, 142 West George street. 1903
 a Campbell, Thomas, Maryhill Iron works. 1894
 160 Campbell, The Right Reverend Archibald E., D.D., Bishop's House, Woodside terrace. 1904
 Cant, James, Kilmeny, Ardrossan. 1901
 Carlaw, Alec Lyle, 14 Fitzroy place. 1908
 Carson, D. S., C.A., J.P., St. Oswalds, Kilmacolin. 1905
 Carswell, John, F.F.P.S.G., L.R.C.P.Ed., 5 Royal crescent, W. 1903
 165 Carver, Thomas, A.B., B.Sc., D.Sc., C.E., 8 Windsor quadrant, Kelvin-side. 1890
 a Cayzer, Sir Charles W., M.P., 109 Hope street. 1886
 Chalmers, A. K., M.D., D.P.H. (Camb.), 7 Buckingham terrace. 1892
 Chalmers, P. MacGregor, I.A., F.S.A.Scot., 95 Bath street. 1891
 a Chisholm, Sir Samuel, Bart., LL.D., 20 Belhaven terrace. 1890
 170 Christie, James Robertson, M.A., LL.B., 3 Gloucester place, Edinburgh. 1903
 a Christie, Henry W., 46 West George street. 1892
 Christie, John, Turkey-red Works, Alexandria, Dumbartonshire. 1868
 a Christison, George, 13 Cambridge drive. 1897
 Chrystal, W. J., F.I.C., F.C.S., Shawfield Works, Rutherglen. 1882
 175 Clanachan, John, 4 Lloyd street, Dennistoun. 1900
 Clark, Geo. H., M.B., Ch.B., D.P.H., 15 Clarence drive. 1908
 Clark, John, M.A., 24 Park gardens, N. Broomhill. 1897
 Cleghorn, Alexander, 14 Hatfield drive, Kelvinside. 1904
 a Cleland, John, M.D., LL.D., D.Sc., F.R.S., Emeritus Professor of Anatomy in the University of Glasgow. 1884
 180a Coats, Archibald, Woodside, Paisley. 1900
 Coats, John J., M.A., 27 Woodside place. 1900
 a Coats, Sir Thomas Glen, Bart., M.P., Ferguslie Park, Paisley. 1905
 Coghill, William C., 24 Douglas street. 1873
 Colquhoun, Walter, M.A., M.B., C.M., 7 Stanley street, W. 1900
 185a Colville, Archibald, The Moorings, Motherwell and Arngomery, Kippen. 1905
 Colville, James, M.A., D.Sc., 14 Newton place. 1885
 Colville, David, Jerviston House, Motherwell. 1905
 a Combe, James Russell, 10 Camphill avenue, Langside. 1895
 a Connell, Charles Broadfoot, Scots-town Shipbuilding Yard, Whiteinch. 1900
 190a Connell, James G., 44 St Enoch's square. 1900
 Cook, William, 77 St Vincent street. 1900
 Cooper, David, Woodend, Giffnock. 1905
 Copland, W. R., 146 West Regent street. 1908
 Corbet, Robert, Actuary, Barcaldine, Springkell avenue, Maxwell park. 1909
 195 Core, Wm, M.D., Stobhill Hospital, Springburn. 1891
 Cormack, J. D., B.Sc., Prof. of Mechanical Engineering, University College, Gower street, London, W.C. 1898
 Coubrough, A. Sykes, J.P., Blane-field, Stirlingshire. 1863
 Coulson, W. Arthur, 47 King street, Mile-end. 1888
 Couper, James, Craigforth House, Stirling. 1862
 200 Couper, Sinclair, Moore Park Works, Helen street, Govan. 1896
 Cowie, Archibald, 20 Blythswood square. 1900
 Craig, T. A., C.A., 139 St Vincent street. 1886
 a Crawford, R. C., 12 Derby crescent, Kelvinside. 1902
 Cree, H. G., 37 West Nile street. 1908
 205 Cree, Thomas S., LL.D., 21 Exchange square. 1869
 a Crookston, George B., 188 St Vincent street. 1900
 Crosbie, Warren, B.L., 141 St. Vincent street. 1904

- Cross, Alexander, M.P., 14 Woodlands terrace. 1887
- aCrum, Walter G., Dalnotter house, Old Kilpatrick. 1895
- 210 Crum, William G., Auchenbowie, Bannockburn. 1896
- aCullen, Alexander, F. R. S. E., F. R. I. B. A., 3 Blythwood square. 1901
- aCulphey, Wm Salvador, 7 Derby crescent, Kelvinside. 1883
- Currie, John, 31 Westbourne gardens. 1905
- aDaly, James, 2 Prince's gardens. 1898
- 215aDalziel, T. Kennedy, M.B., C.M., 196 Bath street. 1896
- Dansken, A. B., 109 St. Vincent street. 1877
- Davidson, David, 7 Bute Mansions, Hillhead. 1905
- Davie, Alexander, 220 St Vincent street. 1906
- Denham, Walter, F.F.A., F.I.A., 2 Kelvinside terrace, N. 1908
- 220 Dewar, David, 362 St George's road. 1903
- Dick, Thomas, 166 St Vincent street. 1901
- Dickie, John S., 30 Renfield street. 1900
- aDixon, James S., Fairleigh, Bothwell. 1900
- Dixon, Walter, Derwent, Kelvinside gardens. 1893
- 225 Dixon, W. Macneile, M.A., Litt.D., Professor of English Language and Literature in the University of Glasgow, 2 South Park terrace, Hillhead. 1906
- Dobbie, A. B., M.A., 24 West Cumberland street, 1885
- aDobbie, Robert, Beechmount, Larchbert. 1900
- aDonald, James Addie, 12 Waterloo street. 1900
- Donald, James, Banker, Springburn. 1908
- 230 Donald, John, 162 West Princes street. 1872
- Donald, William, J. A., Devonport, Greenfaulds, Cumbernauld. 1877
- Donaldson, Henry J., B.L., 124 St Vincent street. 1908
- Donaldson, William G. K., County buildings, Glasgow. 1909
- oDouglas, Campbell, I.A., F.R.I.B.A., 25 Braid avenue, Edinburgh. 1870
- 235 Douglas, James R., Broxtowe, Newark drive, Pollokshields. 1907
- Downie, J. Walker, M.B., C.M., F.F.P.S.G., 4 Woodside crescent. 1901
- Downie, Thomas, HydePark Foundry. 1886
- aDreghorn, David, Greenwood, Pollokshields. 1896
- aDuncan, Eben., M.D., C.M., F.F.P.S.G., Queen's Park house, Langside road, *Hon. Vice-President*. 1873
- 240 Duncan, J. A., Aston, Bridge of Allan. 1896
- aDuncan, Robert, Whitefield Works, Govan. 1890
- Dunlop, David John, Inch Works, Port-Glasgow, and 198 Bath street. 1900
- Dunlop, John, F.E.I.S., headmaster, Quarry Brae Public School, Parkhead. 1900
- Dunlop, John, M.D., 1 Somerset place. 1900
- 245aDunlop, Sir Nathaniel, 25 Bothwell street. 1870
- aDunlop, Thomas, 70 Wellington st. 1902
- Dunn, Robert Hunter, 4 Crown terrace, Dowanhill. 1878
- Dyer, Henry, M.A., D.Sc., C.E., 8 Highburgh terrace, Dowanhill. 1883
- Eadie, George, 405 Mathieson street. 1908
- 250aEdington, George Henry, M.D., M.R.C.S. (Eng.), F.F.P.S.G., 20 Woodside place. 1896
- Edmiston, John C., M.D., F.F.P.S.G., 24 Wilton gardens. 1901
- aEdwards, John, 4 Great Western terrace, west. 1883
- Elliott, Joseph J., City Chambers. 1901
- Ellis, David, D.Sc. (Lond), 1 h.D. (Marburg), Lecturer in Botany, Technical College, Glasgow, Kersland drive, Milngavie. 1905
- 255 Erskine, Jas, M.A., M.B., L.F.P.S.G., 351 Bath street. 1886
- Ewan, Thomas, M.Sc., Ph.D., Wester Auchinloch Farm, Lenzie. 1901
- Ewing, James C., Brighton House, Shettleston. 1902
- aEwing, Wm, 45 Renfield street. 1883
- aFaill, John, 7 Winton drive, Kelvinside. 1901
- 260 Fairweather, Wallace, C.E., 62 St. Vincent street. 1880
- Falconer, John M., Broomhill road, Partick. 1906
- Falconer, Patrick, 13 Sutherland street, Hillhead. 1876
- aFarquhar, Jas T., 47 Hope street. 1901
- Farquhar, Wm R., St Malo, Kilmalcolm. 1892
- 265 Farrelly, John, 25 Elmbank cres. 1901
- Fawsitt, Charles A., 9 Foremount terrace, Partick. 1879

- aFergus, Freeland, M.D., F.R.S.E.,
 F.F.P.S.G., *Hon. Secy.*, 22 Blyths-
 wood sq. 1887
 Fergus, James, 58 York street. 1901
 aFergus, Oswald, D.D.S., L.D.S.,
 F.R.S.E., 12 Clairmont gardens. 1896
 270a Ferguson, David, Glenholm, Port-
 Glasgow. 1901
 Ferguson, George, 130 Bishop street,
 Port Dundas. 1904
 aFerguson, John, M.A., LL.D., F.R.S.E.,
 Professor of Chemistry, University
 of Glasgow, *Hon. Vice-President.* 1869
 Ferguson, John A., Kilmeny, Kirk-
 lee, Glasgow. 1905
 Ferguson, John Forbes, 166 St
 Vincent street. 1895
 275 Fleming, Dr Robert H., 19 Newton
 street, Charing cross. 1901
 aFleming, E. Brown, Kilchran, by
 Oban, Argyllshire. 1900
 aFleming, Sir James, 136 Glebe st. 1880
 aFleming, John, 241 St Vincent st. 1900
 Fleming, John T., M.A., 129 Bath
 street. 1908
 280 Flower, Collingwood, Balyward
 house, Torrance. 1901
 Forgan, D. L., 302 Buchanan street. 1908
 Foster, W. A., St Catherine's, New-
 lands road, Langside. 1899
 Fotheringham, T. B., 52 Barrland
 street, Maxwell road. 1889
 aFowler, John, 164 St. Vincent street. 1880
 285 Fraser, Melville, 31 St Vincent place. 1890
 aFraser, Robert, 55 West Regent st. 1909
 aFraser, Thomas Smellie, F.S.I.,
 209 St Vincent street. 1900
 aFraser, Wm, F.S.I., 209 St Vin-
 cent street. 1900
 aFrench, Thomas, 1 Kelvininside ter. 1897
 290 Frew, Alex., C.E., Assoc. M.Inst.C.E.,
 216 West George street 1876
 aFrew, William, Ph.D., c/o H.
 Whiteway, Esq., Tae Orchard,
 Whimble, Devon. 1898
 Fryers, Arthur John, 22 Bath street,
 Largs. 1899
 Fullarton, Professor Robert, M.A.,
 M.B., F.F.P.S.G., 272 Bath
 street. 1903
 aFullerton, Robt., M.D., 24 Newton
 place. 1896
 295 Fulton, James, The Glen, Paisley. 1897
 Fulron, James, 33 Hamilton drive,
 Hillhead. 1902
 Fyfe, A. Peden, 124 St Vincent
 street. 1900
 Fyfe, Henry B., 115 St Vincent
 street. 1892
 Fyfe, John W., F.S.I., 221 West
 George street. 1905
- 300a Gairdner, C. D., C.A., 115 St Vin-
 cent street. 1886
 Galbraith, John Alexander, 28
 Belhaven terrace. 1902
 Galbraith, Peter, 4 Beaumont Gate,
 Downanhill. 1889
 Galbraith, Walter M., 7 Holyrood
 crescent. 1893
 Galloway, T. Lindsay, C.E., 175
 West George street. 1881
 305 Gardiner, F. C., 14 St. Vincent
 place. 1907
 Gardiner, James, Belleville, Hatfield
 drive, Kelvininside. 1908
 Gardiner, William G., 4 Buckingham
 terrace, Glasgow. 1907
 Gardner, Alexander, Architect, 134
 Bath street. 1906
 Gardner, Daniel, 36 Jamaica street. 1869
 310 Gardner, John, 146 Trongate. 1901
 Gardner, John R., 33 Huntly gardens,
 Kelvininside. 1900
 aGarrett, Geo., Dunbeth lodge, Coat-
 bridge. 1901
 aGarrow, James R., 6 Pollok road. 1890
 aGarraway, John, 694 Duke st. 1875
 315 Gemmill, James Fairlie, M.A., M.D.,
 21 Endsleigh gardens. 1901
 Gemmill, William, 140 Woodstock
 avenue, Shawlands. 1903
 Gibson, Charles R., Lynton, Manse-
 wood, by Pollokshaws. 1895
 Gibson, James, M.A., Head Master,
 Woodside Public School. 1905
 Gillies, F. H., Thornly Park, Potter-
 hill, Paisley. 1905
 320a Gillies, William, 23 University
 gardens. 1901
 Gillies, W. D., 17 Royal Exchange
 square. 1872
 Glaister, John, M.D., F.F.P.S.G.,
 D.P.H. (Camb.), F.R.S.E., F.C.S.,
 &c., Professor of Forensic Medi-
 cine and Public Health, University
 of Glasgow, 3 Newton place. 1879
 aGlaister, Joseph Newbigging, M.B.,
 C.M., 4 Grafton place. 1900
 aGlen, Lawrence, 153 St Vincent
 street. 1900
 325 aGlen, Robert, Carlston, Kelvininside. 1901
 Goldie, James, 52 St Enoch square. 1883
 Goodwin, Robert, C.E., 3 Lynedoch
 street. 1875
 Goold, James B., Bank of Scotland,
 Trongate. 1902
 aGordon, James, Stonebyres, 14
 Aytoun road, Pollokshields. 1901
 330a Gourlay, Charles, B.Sc., A.R.I.B.A.,
 Professor of Architecture, Glasgow
 Technical College, 30 Hamilton
 drive, Hillhead. 1900

- Gourlay, Robert, LL.D., 5 Marlborough terrace. 1904
 Gow, Leonard, 45 Renfield street. 1889
 Gow, Leonard, jun., 45 Renfield street. 1884
 Graham, Sir John Hatt Noble, Lambert House, Stirlingshire. 1900
 335a Graham, Robert, 108 Eglinton street. 1888
 aGraham, William, B.L., 198 West George street. 1885
 Graham, Wm Edward Auld, 7 Royal Bank place. 1900
 Grant, Rev. James Bell, B.D., 113 Hillstreet, Garnethill, St. Stephen's Parish Church. 1903
 Gray, Albert A., M.D., 14 Newton terrace. 1903
 340 Gray, Andrew, LL.D., F.R.S., Professor of Natural Philosophy in Glasgow University. 1899
 aGray, Thomas, D.Sc., Ph.D., F.I.C., F.C.S., Professor of Technical Chemistry, Glasgow Technical College. 1904
 aGregory, Professor J. W., D.Sc., F.R.S., Glasgow University. 1904
 Green, George, J.P., 40 Balshagray avenue, Partick. 1900
 Greer, Thomas Arthur, Fairfield works, Govan. 1901
 345 Greig, James R., Ravenswood, Crosshill. 1897
 Grieve, W. Weir, 6 Bowmont terrace, Kelvinside. 1905
 Gunn, John, B.L., 223 St Vincent street. 1901
 Guy, Robert, 120 West Regent street. 1905
 aHamilton, John, I.A., 212 St Vincent street. 1885
 350 Harrington-Stuart, R. E. S. (Colonel), Torrance, East Kilbride, N.B. 1900
 Harrington, John C., 3a So. Hanover street. 1901
 aHarrington, J. P., Broadfield, Port-Glasgow. 1900
 Harris, F. W., 32 Kyle Park, Uddingston. 1900
 Harrison, John, J.P., 7 Granby ter. 1900
 355a Henderson, Andrew, 15 Cadogan street. 1906
 aHenderson, A. P., 20 Newton place. 1880
 Henderson, Francis, St Vincent place. 1901
 Henderson, George G., M.A., D.Sc., F.I.C., F.C.S., Professor of Chemistry, Glasgow and West of Scotland Technical College, 204 George street. 1883
 Henderson, John, Reigate, Surrey. 1890
 360a Henderson, Thomas, 1 Lancaster crescent, Kelvinside. 1900
 Henderson, Thomas Beath, M.D., 25 Lansdowne crescent. 1899
 aHenderson, William, 15 Cadogan street. 1873
 Hendry, Geo. Scott, 310 St. Vincent street. 1895
 Henry, R. W., 21 Oakfield ter., W. 1875
 365 Hewat, Andrew, J.P., 9 Berkeley terrace. 1906
 Higgins, Henry, jun., 248 West George street. 1878
 Hill, Thomas N., F.S.I., 180 Hope street. 1905
 Hinshelwood, James, M.A., M.D., 26 Woodside place. 1896
 Hinshelwood, Thomas, Kenryhill house, Dennistoun. 1903
 370a Hope, James, Dean house, Lenzie. 1898
 Horne, Joseph, M.B., C.M., 45 Windsor terrace. 1900
 aHouldsworth, J. H., Rozelle, Ayr. 1900
 aHouldsworth, Wm Thos, Clerk in Holy Orders, 1 Mansfield street, Portland place, London, W. 1901
 Houston, Wm Henry, Glasgow Rubber Works, Glasgow. 1895
 375 Howat, William, 9 Parkgrove ter. 1885
 aHunt, John, Milton of Campsie. 1881
 aHunter, Richard H., Glentyan, Kilbarchan, Renfrewshire. 1900
 Hunter, Robert, 72 Waterloo street. 1901
 Hunter, Walter K., M.D., 7 Woodside place. 1899
 380a Hunter, Wm S., 70 Robertson st. 1889
 Hutchison, John C., 8 Lansdowne crescent. 1900
 Hutchison, John, M.A., LL.D., 199 Renfrew street, Garnethill. 1909
 Hutchison, William, LL.B., 208 West George street. 1908
 aHyslop, William, of Bank, New Cumnock. 1901
 385 Inglis, John, LL.D., Pointhouse Shipyard. 1895
 aInglis, Malcolm, 5 Lancaster cres., Glasgow, W. 1900
 Inglis, R. A., Culrain, Bothwell, 1889
 Innes, Gilbert, 16 Kirklee road, Kelvinside. 1900
 Inverclyde, The Right Hon. Lord, 30 Jamaica street. 1905
 390a Irons, Joseph Jones, Summerlea, Kilcraggan. 1902
 Jack, George, 2 Wilton gardens, Kelvinside. 1905
 Jack, William Robert, M.D., 43 Lansdowne crescent. 1899

- aJack, Wm., M.A., LL.D., Emeritus
 Professor of Mathematics, Glasgow
 University. 1881
 aJackson, Harold D., Canton street,
 Anniesland. 1902
 395 Jackson, Robert, 16 Dixon avenue,
 Crosshill. 1902
 Jackson, Thomas, C.A., 24 George
 square. 1900
 Jenkins, James Graham, Airedale,
 Cambuslang. 1901
 Johnston, Alex., M.D. (Glasgow),
 D.P.H. (Camb.), Ruchill Hospital. 1900
 Johnston, David, 160 West George
 street. 1891
 400 Johnston, William G., Anchor
 Chemical Works. 1901
 Jones, Thomas, M.A., Prof. Political
 Economy, University, Belfast. 1906
 Jubb, John, B.L., 124 St Vincent St. 1902

 Kay, Arthur, J.P., Tregortha,
 Winton drive. 1904
 Kay, Cathcart, 77 St Vincent street. 1900
 405 Kay, Thomas, M.B., C.M., 5 Rose-
 berry terrace. 1899
 Kean, James, 31 Scotia street,
 Garnethill. 1888
 Kedic, Robert, 11 Eglinton drive,
 Kelvinside. 1905
 aKelly, Alexander, 100 Hyde Park
 street. 1901
 aKelly, A. Brown, M.D., D.Sc., 26
 Blythswood square. 1903
 410 Kelly, Hugh, M.D., Catrine Bank,
 Shields road, Pollokshields. 1898
 Kelly, James K., M.D., F.F.P.S.G.,
 Park villa, Queen Mary avenue,
 Crosshill. 1889
 Kelly, John Davidson, M.A., Stanley
 house, Bridge-of-Allan. 1901
 Kemp, Wm (Alexander, Fergusson,
 & Co., Ltd), Ruchill, Maryhill. 1898
 aKennedy, Alexander, Kenmill House,
 Bothwell. 1902
 415 Kennedy, James, 43 Greendyke st. 1889
 Kennedy, John, Airdrie. 1904
 aKennedy, Moses Hunter, 217 West
 George street. 1901
 aKennedy, William, 13 Victoria
 crescent, Dowanhill. 1900
 aKer, Charles, M.A., C.A., 115 St
 Vincent street. 1885
 420aKer, Wm, 1 Windsor terrace, Kelvin-
 side, West. 1874
 Kerr, John G., M.A., LL.D., 15
 India street. 1878
 Kerr, J. Graham, M.A., F.R.S.,
 Professor of Zoology, University of
 Glasgow, 12 Oakfield terrace,
 Hillhead. 1904

 Kerr, Thomas, 8 Dugoyne gardens,
 Maryhill. 1908
 Kerr, William, 260 West George
 street. 1902
 425 Kidston, Geo. J., Finlaystone, Lang-
 bank. 1930
 Kidston, J. B., 50 West Regent st. 1905
 aKidston, William H., 81 Great
 Clyde street. 1900
 aKiep, Johannes N., Imperial German
 Consul, 137 West George street. 1900
 aKing, Chas M., Antermony house,
 Milton of Campsie. 1900
 430 King, Sir James, Bart, LL.D., of
 Campsie, 115 Wellington street. 1855
 King, John, 17 Queen's crescent. 1895
 King, John C., J.P., 21 Newton
 place. 1898
 King, Professor L. A. L., 10 Cole-
 brooke street, Kelvinside. 1905
 King, Robert, 115 Wellington st. 1905
 435 Kirk, Rev. Edward Bruce, E.U.
 Manse, Barrhead. 1905
 Kirkpatrick, Alexander B., 101 St
 Vincent street. 1885
 Kirkwood, Charles, 67 West Regent
 street. 1908
 Kirkwood, James, Carling lodge,
 Ibrox. 1890
 Knight, James, M.A., D.Sc., F.C.S.,
 F.G.S., F.E.I.S., The Shieling,
 Uddington. 1893
 440aKnox, David J., 19 Renfield street. 1890
 Knox, John, Finnieston School. 1900
 aKnox, John, 13 Montgomerie quad-
 rant, Kelvinside. 1902

 Lackie, W. W., 75 Waterloo street. 1905
 Laird, John, Royal Exchange Sale
 Rooms. 1879
 445 Lamb, David, 155 Hyndland road. 1896
 Lamberton, Andrew, Blairtummock,
 Easterhouse. 1904
 Lamberton, Hugh Alexander, Bewdly,
 Hags road, Pollokshields. 1901
 aLamberton, Hugh, Surbiton, 52
 Dalziel drive, Pollokshields. 1900
 Lambie, Robert, Strathview, Lark-
 hall. 1901
 450 Lamond, Robert, M.A., LL.B., 163
 West George street. 1894
 Lanchester, W. F., M.A., Den of
 Gryffe, Kilmacolm. 1908
 Lang, William, Crosspark, Partick. 1865
 aLanglands, E. W., 131 West Regent
 street. 1902
 aLauder, James, F.R.S.L., Glasgow
 Athenæum. 1892
 455aLauder, John, 46 Gordon street. 1894
 Laughland, David, 11 Newton ter-
 race, Glasgow, W. 1901

- Laurie, Malcolm, B. A., D. Sc., F. L. S.,
Professor of Zoology, The Bloom,
Canaan lane, Edinburgh. 1901
- Law, A. Bonar, M. P., Kintillo,
Helensburgh. 1905
- Law, Jas H., Brandon house, Ibrox. 1901
- 460 Law, John R. K., 20 Ashton
gardens, Dowanhill. 1896
- Lawrie, Sir Archibald C., LL. D.,
The Moss, Dungoyne, Stirling-
shire. 1905
- a Lawson, Thomas, Birchgrove, Pollok-
shields. 1901
- a Lindsay, Archd M., M. A., 87 West
Regent street. 1872
- a Lindsay, John, Conylea, Westbourne
gardens, Kelvinside. 1902
- 465 Lipton, Sir Thomas J., Bart.,
K. C. V. O., Grand Officer of the
Crown of Italy, Osidge, Southgate,
Middlesex. 1905
- Lobban, William, M. A., Hillesden,
Giffnock. 1905
- Lochhead, Dugald Ferguson, 41
Kelvinside gardens, Kelvinside. 1902
- Logan, James, Grammar School,
Uddingston. 1902
- Lothian, A. Veitch, M. A., B. Sc.,
F. R. S. E., Lecturer, Glendoune,
Bearsden. 1891
- 470 Love, James Kerr, M. D., C. M.,
173 Bath Street. 1888
- Love, Wm., 28 Royal Exchange
square. 1901
- a Low, Isaac, 60 Weaver street. 1898
- a Lumsden, Harry, M. A., LL. B.,
105 West George street. 1900
- Lumsden, James, Arden House,
Arden, Dumbartonshire. 1905
- 475 Lundholm, C. O., Nobel's Ex-
plosives Factory, Ardeer, Steven-
ston. 1890
- M'Ara, Alexander, 65 Morrison st. 1888
- Macara, James, 19 Waterloo street. 1901
- Macara, James, Banker, 140 St. Vin-
cent street. 1907
- M'Arly, Thomas, 29 W. George st. 1897
- 480a M'Arthur, John S., 74 York street. 1890
- M'Ausland, William F., 51 Buchanan
street. 1903
- Macbean, Ed, F. R. G. S., F. R. S. L.,
31 Athole gardens. 1901
- M'Bryde, Peter, M. B., 18 Queen's
crescent, W. 1900
- M'Calman, George, 1 India st., W. 1905
- 485a M'Callum, Hugh, M. A., 7 Bute
Mansions, Hillhead. 1902
- a M'Callum, Robert, junr., 69 Union
street. 1891
- a M'Clelland, Andrew Simpson, C. A.,
4 Crown gardens, Dowanhill. 1884
- M'Conville, John, M. D., 14 Park-
grove terrace. 1870
- M'Connachie, John, 204 West George
street. 1905
- 490 M'Cosh, Andrew K., Cairnhill,
Airdrie. 1901
- a M'Cowan, David, jun., 9 Park
circus place. 1898
- M'Cracken, James, 5 Bowmont
terrace, Kelvinside. 1889
- M'Crae, John, 7 Kirklee gardens,
Kelvinside. 1876
- M'Creath, James, M. E., 208 St
Vincent street. 1874
- 495 M'Culloch, Hugh, 154 W. Regent st. 1880
- M'Donald, Alexander Beith, M. Inst.
C. E., city engineer, City Cham-
bers. 1901
- MacDonald, Andrew, Sherbrooke,
Pollokshields. 1909
- MacDonald, Charles, 55 Lochleven
road, Langside. 1902
- a M'Donald, John, 72 Great Clyde st. 1896
- 500 M'Dougall, Alexander, M. A., B. Sc.,
3 Alexandria terrace, Govan. 1909
- a Macdougall, Robert, F. S. A. A.,
F. S. I., 63 Bank street, Hillhead. 1900
- Macfarlane, Dr Wm D., 17 Woodside
crescent. 1906
- Macfarlane, Dr Wm D., Jun., 17
Woodside crescent. 1906
- a Macfarlane, Walter, 22 Park circus. 1885
- 505 M'Farlane, Wm, Edna Lodge,
Rutherglen. 1888
- Macfee, John, M. I. E. E., 65 Renfield
street. 1905
- Macgeorge, B. B., 24 George square. 1905
- MacGillivray, Duncan, M. A., 7
Newark drive, Pollokshields. 1906
- a M'Gilvray, R. A., 6 Newton ter. 1880
- 510 MacGregor, D. O., M. D., Victoria
Infirmiry. 1904
- a Macgregor, R. D., 137 West George
street. 1900
- Machill, Thomas, 1 Burnbank ter. 1886
- a Macindoe, Alex., 104 West George
street. 1894
- Macintyre, John, M. B., C. M., 179
Bath street. 1895
- 515a M'Intyre, T. W., 21 Bothwell st. 1900
- Macintyre, Wm, F. E. I. S., Dalmar-
nock School, Glasgow. 1888
- Mackay, David N., 173 St Vincent
street. 1909
- Mackay, R. C., 82 West Regent st. 1903
- a M'Kechnie, D., 14 Candleriggs. 1900
- 520a M'Kechnie, Wm S., M. A., LL B.,
D. Phil., Knightswood, Elderslie,
Renfrewshire. 1908
- M'Kellar, John C., 45 West Nile
street. 1896

- M'Kellar, J., 25 Kelvinside terrace. 1893
 Mackendrick, Alex., 518 Sauchiehall street. 1905
 aM'Kendrick, John G., M.D., C.M., LL.D., F.R.S., F.R.S.E., F.R.C.P.E., *Emeritus*-Professor of Physiology in the University of Glasgow, Maxieburn, Stonehaven, N.B. *Hon. Vice-President*. 1877
 525 M'Kendrick, J. Souttar, M.D., F.R.S.E., 2 Buckingham terrace. 1900
 Mackenzie, Robert, 176 St Vincent st. 1905
 aM'Kenzie, W. D., 43 Howard street. 1875
 M'Kerrow, W. L., 65 Hamilton drive, Hillhead. 1908
 M'Kie, John, M.B., C.M., 24 Hillside terrace. 1899
 530 Mackillop, Fred. G., M.A., LL.B., 208 St Vincent street. 1901
 aMackinlay, James Murray, The Lee, Merchiston, Edinburgh, 1886
 aMackinlay, J. T. C., 60 Montgomerie drive, Kelvinside. 1900
 Mackintosh, Donald J., M.B., C.M., M.V.O., Western Infirmary, 1894
 Mackintosh, Walter, 19 Roxburgh street, Kelvinside. 1905
 535a Mackinnon, John, 170 Hope street. 1904
 Mackinnon, William, C.A., 34 West George street. 1904
 MacLachlan, Dugald, B.L., 30 Renfield street. 1907
 MacLae, A. Crum, 192 St Vincent street. 1884
 M'Laren, Robert, Royal Bank, Garscube cross. 1898
 540 M'Lay, James, C.A., 94 Hope street. 1900
 Maclay, William, Thornwood Hall, Langside. 1893
 M'Lean, Angus, B.Sc.(Lond.), C.E., Principal, Technical College, Paisley. 1897
 Maclean, A. B., Craigpark Works, Flemington street, Springburn. 1899
 Maclean, Magnus, M.A., D.Sc., F.R.S.E., Professor of Electrical Engineering, Glasgow and West of Scotland Technical College, 51 Kersland terrace, Hillhead. 1885
 545a MacLehose, James, M.A., 61 St Vincent street, 1882
 MacLellan, Lewis, 5 Bowmont gardens. 1899
 aMacLellan, Peter, Glasgow Rubber Works, Maryhill. 1900
 aMacLellan, Robert, 3 Clairmont gardens. 1908
 aMacLellan, Wm. Walter, 3 Montague terrace, Kelvinside. 1900
 550a Macleod, A., 54 Tyiherton road, Tufnell park, London, N. 1893
 aMacleod, Frederick Larkins, 142 St. Vincent street. 1901
 M'Michael, James, jun, 1 Argyle arcade. 1908
 M'Michael, Thomas, M.A., B.Sc., Nethercraig, Milner road, Jordanhill. 1901
 M'Millan, A. Lewis, M.D., C.M., 1 Rosebery terrace, Great Western road. 1897
 555 M'Millan, Archibald, 5 Whittinghame gardens. 1899
 M'Millan, Robert, Methlan park, Dumbarton. 1901
 aMacnab, James, Lilyburn, Milton of Campsie, Stirlingshire. 1901
 Macphail, Donald, M.D., Garturk cottage, Whifflet, Coatbridge. 1877
 Macquaker, Thomas, 89 West Regent street. 1902
 560 Mactaggart, John A., Kelmscott, Springkell avenue. 1908
 M'Vail, D. C., M.B., Professor of Clinical Medicine, St Mungo's College, 3 St James' terrace, Hillhead. 1873
 M'Vail, John C., M.D., D.P.H. (Camb.), 20 Eron place, Hillhead. 1904
 aMacwhannell, Ninian, 58 West Regent street. 1898
 M'Whirter, W., 3 Albany street, Kelvinside. 1901
 565 Main, Robert B., Lyndhurst, 1 Winton drive, Kelvinside. 1885
 Malloch, A. M., Firhill, Carscube road. 1896
 aMann, James, Castlecraig, Dolphinton, Peeblesshire. 1900
 aMann, John, C.A., 142 St Vincent street, *Hon. Treasurer*. 1856
 aMann, John, jun., M.A., C.A., 142 St Vincent street, *Vice President*. 1885
 570 Mann, Ludovic MacLellan, 144 St Vincent street. 1897
 aMann, Robert M., Rheubeg, Busby. 1900
 Manwell, James, The Hut, 4 Albert drive, Pollokshields. 1876
 Marks, Samuel, 145 Great Eastern road. 1884.
 Marr, John, J.P., Dunjarg, Bellahouston, Govan. 1900
 575 Marr, Hamilton Clelland, M.D., Woodilee Asylum, Lenzie. 1899
 Marshall, James, Woodcroft, Crow road, Partick. 1900
 aMarshall, Robert, 97 Wellington street. 1900
 Martin, James F., 63 Brunswick street. 1895
 Martin, John, writer, 58 West Regent street. 1901

- 580 Martin, Robert, 23 Wilson street, Hillhead. 1897
 Martin, William, 63 Brunswick street. 1903
 Mathie, George M., Mayfield Clin-carthill. 1895
 Mathieson, J. H., 6 Park circus place. 1896
 aMathieson, T. O., 1 Park gardens. 1896
 585 Mavor, Henry A., 47 Broad street, Mile-end. 1887
 Mavor, Samuel, 37 Burnbank gardens. 1890
 aMaxwell, Sir John Stirling, Bart., Pollok House, Pollokshaws. 1905
 May, A. H., 15 Athole gardens. 1898
 Mechan, Arthur, Scotstoun Iron-works. 1876
 590aMechan, Henry, Scotstoun Iron Works, Scotstoun. 1879
 Medley, Dudley J., M.A., Professor of History in Glasgow University, 2 Park quadrant. 1901
 Mellanby, A. L., D.Sc., Professor of Motive Power Engineering, The Technical College, Glasgow. 1905
 Menzies, William Crawford, City Improvement Trust, 22 King st. 1895
 Millar, James, 152 Parliamentary road. 1870
 595aMiller, Alexander Wingate, 79 West Nile street. 1900
 Miller, Alexander, junr., 34 Rose street, E. 1899
 aMiller, Arch. Russell, Queensmount Helensburgh. 1884
 aMiller, George, Surrey House, Victoria Embankment, London, W.C. 1881
 Miller, Hugh, M.A., F.E.I.S., 2 Bogton Avenue, Cathcart. 1901
 600 Millar, James G., Sheriff of Lanarkshire, 5 Lorraine gardens. 1908
 aMiller, J. C., 188 St Vincent street. 1900
 aMiller, Thomas Hodgson, Westcroft, Cleveland Walk, Bath. 1901
 aMirrlees, William J., 45 Scotland street. 1889
 Mitchell, Alexander Brown, Glenview, Larkhall. 1901
 605aMitchell, Alex. Moncrieff, 8 Kew terrace, Kelvinside. 1903
 Mitchell, Andrew, C.A., The Glasgow District Subway Co., St Enoch square Station. 1896
 aMitchell, Andrew Acworth, 7 Huntly gardens. 1903
 aMitchell, George A., F.R.S.E., 5 West Regent street. 1883
 Mitchell, Wm James, M.A., B.L., 48 West George street. 1897
- 610aMoffatt, Alexander, 23 Abercromby place, Edinburgh. 1874
 Mollison, James, 30 Balshagray aven., Partick. 1889
 aMond, Robert Ludwig, B.A. (Cantab.), F.R.S.E., 20 Avenue rd., Regent's park, London, N.W. 1890
 aMonro, T. K., M.A., M.D., F.F.P.S.G., Professor of Medicine in St Mungo's College, 12 Somerset place. 1897
 aMonteith, Robert, Greenbank, Dowanhill gardens. 1885
 615 Moore, Alexander, C.A., Deanville, Bridge of Allan. 1869
 Moore, Alexander George, M.A., B.Sc., 13 Clairmont gardens. 1886
 aMoore, Robert Thomas, D.Sc., 13 Claremont gardens. 1904
 Morison, John L., M.A., The University, Glasgow. 1907
 Morrice, Jas A., 1 Prince's ter., Dowanhill. 1883
 620aMorton, George, Horslethill road, Kelvinside. 1902
 Motion, James Russell, 266 George street. 1887
 Motion, Thomas Mason, 54 Grant street, W. 1897
 Muir, Alexander, 134 Nithsdale road, Strathbungo. 1883
 aMuir, Allan, Ardmay, Newlands road, Langside. 1881
 625aMuir, James, D.Sc., M.A., Professor of Natural Philosophy, Technical College, Glasgow, 189 Renfrew st. 1904
 Muir, Robert, M.D., F.R.C.P.E., Professor of Pathology in Glasgow University, 16 Victoria crescent, Dowanhill. 1899
 aMuirhead, Andrew Erskine, Cart Forge, Cathcart. 1873
 Muirhead, James, 2 Bowmont gardens, Kelvinside. 1887
 aMuirhead, Robert F., M.A., D.Sc., 64 Great George street, Hillhead. 1879
 630 Munro, Alexander, M.B., C.M., 12 Seton Terrace, Dennistoun. 1900
 aMunro, Donald Mackay, 88 St Vincent street. 1901
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 Murdoch, George, 40 St Vincent pl. 1894
 Murdoch, John, 208 West George st. 1901
 635 Murdoch, John, Chemist, 694 Duke street. 1907
 aMurdoch, Robert, 91 Maxwell road. 1880
 aMurray, A. S. 169 West George street. 1905
 Murray, C. Hope, jun., 98 West George street. 1908

- Murray, Charles Robert, Woodbank, Partickhill. 1902
- 640a Murray, Daniel, 5 Wilton crescent. 1896
- aMurray, David, LL.D., 169 West George street, *Hon. Vice-President*. 1876
- Murray, John Bruce, 24 George square. 1890
- Murray, J. Campbell, 216 West George street. 1906
- Murray, R. A., C.A., 175 West George street. 1905
- 645a Naismith, William W., C.A., 57 Hamilton drive, Hillhead. 1907
- Napier, Alex., M.D., F.F.P.S.G., Rose Bank, Queen Mary avenue, Crosshill. 1886
- Napier, Robert T., Schiehallion, Dunblane. 1899
- aNeilson, George, LL.D., Wellfield, Partickhill road. 1897
- aNeilson, James, 116 Bishop street, Port-Dundas. 1896
- 650a Neilson, John, Mollance, Castle-Douglas. 1900
- aNeilson, Walter, Ewenfield, Ayr. 1900
- Nelson, Alex., 63 North Frederick street. 1880
- aNelson, John E., 26 Queen street. 1900
- Ness, James, M.A., LL.B., 100 West Regent street. 1904
- 655 Ness, Professor R. Barclay, M.A., M.B., 19 Woodside place. 1902
- aNewlands, Joseph F., 105 West George street. 1883
- Nicol, James Monro, 93 Cheapside street. 1901
- Nicol, William Smith, F.F.A., 30 Renfield street. 1905
- Nicolson, W. B., 54 Hill street, Garnethill. 1906
- 660a Nicoll, Professor James H., M.B., 4 Woodside place. 1897
- aNisbet, John, 112 Bath street. 1905
- Nish, Robert, 9 Claremont terrace. 1897
- Orr, George Smith, 139 St Vincent street. 1901
- aOsborne, Hugh, 4 Kew terrace, 665a Oswald, Dr Landel Rose, Glasgow Royal Asylum. 1902
- aPark, Colonel J. Smith, V.D., 20 Park terrace. 1900
- Parker, James H., B.L., C.A., 89 West Regent street. 1900
- Parker, Dr W. A., Glasgow District Asylum, Gartloch. 1908
- aParker John Dunlop, C.E., 146 West Regent street. 1889
- 670a Parnie, William, 27 Union street. 1897
- Parry, Robert Henry, F.R.C.S.E., 25 Blythswood square. 1900
- aPaterson, Robert, C.A., J.P., 105 West George street. 1881
- Paterson, Thomas Y., 4 Lorraine gardens, Dowanhill, Glasgow. 1907
- Paterson, Wm., M.B., C.M. (Edin.) 43 Millbrae Road, Langside. 1902
- 675 Paton, James, F.L.S., Glasgow Art Gallery and Museum, Kelvin-grove. 1876
- Paton, Professor D. Noël, M.D., B.Sc., F.R.C.P.E., 4 University gardens. 1908
- Patrick, Joseph, M.A., C.A., 203 West George street. 1893
- Patrick, Joseph, Royal Exchange buildings. 1900
- Patterson, T. L., F.C.S., Maybank, Finnart street, Greenock. 1873
- 680 Petrie, John W., 4 Garrioch drive, Kelvinside, N. 1900
- Pettigrew, Andrew H., 3 Claremont terrace. 1902
- aPicken, David Kennedy, B.A., Victoria College, Wellington, New Zealand. 1903
- Pinkerton, Surgeon-Major-General, J., M.D., K.H.P., Queen's Park House, Langside. 1900
- aPirrie, Robert, 9 Buckingham ter. 1875
- 685 Playfair, David James, 7 Victoria crescent, Dowanhill. 1901
- Pollock, A. Barr, M.B., C.M., 3 Belgrave terrace, Hillhead. 1897
- Prentice, Thomas, 15 Eglinton drive, Kelvinside. 1905
- Provand, A. D., 2 Whitehall court, London, S.W. 1888
- Purdie, Anthony, F.S.I., 241 West George street. 1908
- 690 Purdie, Wm G., 3 Gower street, Kelvinside. 1906
- Raalte, Jacques Van, c/o M. Van Raalte, Esq., 22 Austen Friars, London, E.C. 1884
- aRalston, William Henry, 4 North Court, Royal Exchange. 1900
- Ramsey, Robert, 14 Park terrace. 1889
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- 695 Rankine, Adam, Rolandseck, Bridge of Weir. 1901
- Rankine, David, C.E., 238 West George street. 1875
- aReid, Andrew Thomson, 10 Wood-side terrace. 1900
- Reid, David, 44 Lilybank gardens, Hillhead. 1887
- aReid, Hugh, Belmont, Springburn. 1880

- 700a Reid, James A., Dean of Faculty of
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a Reid, Joseph, 32 Newark drive,
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a Reid, Nicholas M'Whirter, 7 Oakley
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705a Reid, Walter M. N., 10 Woodside
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a Reid, William L., M.D., 7 Royal
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Renton, James Crawford, M.D.,
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a Rennie, John, Wellcroft, Helens-
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710 Rennie, Thomas, Glasgow Art Gallery
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a Renwick, Wm, Langgarth, Stirling. 1901
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715a Robertson, William, 223 Sauchiehall
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a Robertson, Henry Tod, Meadow-
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720 Robertson, William, 45 West Nile
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a Rogers, John C., 204 Bath street. 1888
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a Ross, John, Lochbrae House, Bears-
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725 Ross, John, Munn, C.A., 117 Wel-
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a Rottenburg, Paul, LL.D., 55 West
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730 Rowan, W. G., 234 West George
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a Rowley, Thos, Campbell street,
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a Samuel, John Smith, F.R.S.E., J.P.,
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735 Sandeman, B., Ferndean, Lenzie. 1900
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a Sawers, George B., Hydepark Loco-
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745 Service, R. Gibson, 14 Royal Ex-
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755a Simpson, J. C., M.D., 9 Marl-
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Smart, William, M.A., LL.D., Pro-
fessor of Political Economy, Uni-
versity of Glasgow, Nunholm,
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Smellie, James, I.M., 112 Bath street. 1901

- 762a Smith, Andrew, Miltonlea, Kilma-
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aSmith, Lewis O., 2 Windsor terrace,
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770a Smith, W. B., 34 Newark drive,
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aSmith, W. Robertson, 8 Windsor
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Soddy, Frederick, M.A., Chemistry
Department, Glasgow University. 1904
775 Speirs, William, Junr., Invershiel,
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aSpencer, Charles L., Edgehill, Kel-
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aSpencer, J. J., Edgehill, Kelvinside. 1895
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aSteel, James, M.A., 502 St Vincent
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780a Steel, William Strang, Philiphaugh,
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aStephen, John, Domira, Partick. 1880
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aStevenson, D. M., 12 Waterloo
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785 Stevenson, J. V., Dunacre, Beech
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795a Stobo, Thomas, Somerset house.
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Stockdale, H. F., Clairinch, Upper
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Stockman, Ralph, M.D., F.R.S.E.,
Professor of Materia Medica, The
University of Glasgow. 1897
Stoddart, James Edward, Howden,
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Strachan, George, Fairfield Works,
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800a Strain, James M., 15 Kingsborough
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aStrain, John, C.E., Cassilis House,
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aSutherland, David, Balmaccara Hotel,
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aSutherland, John, Columba Hotel,
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805 Sutherland, J. R., C.E., 45 John
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Syme, W. S., M.D.(Edin.), 10 India
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810 Tatlock, John, F.I.C., 13 Parkgrove
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aTennent, Gavin P., M.D., 159 Bath
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820a Thomson, Edward J., Western Club. 1904
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 a Waddell, Robert Davidson, Red-
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 830 Walker, Adam, 2 Newton place. 1880
 a Walker, Alexander, City Chambers. 1903
 a Walker, Archibald, M.A. (Oxon.),
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 Walker, J. W. O., Oakfield, Man-
 chester road, Irlams-o'-th'-Height,
 near Manchester. 1896
 a Walker, William H., Cardarroch
 House, Airdrie. 1900
 835 Wallace, James Wilson, M.D., C.M.,
 Cairnsmore, 67 St Andrew's drive,
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 Wallace, William, M.A., LL.D.,
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 a Walker, Hugh, M.A., M.B., C.M.,
 52 Kilmarnock road, Shawlands. 1903
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 840a Wardlaw, Alex., The Clydesdale
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 845 Watson, James, Cluniter, Inellan. 1873
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 Crosshill. 1900
 Watson, Joseph, Chappell, Barrhead. 1882
 a Watson, J. Robertson, M.A., Pro-
 fessor of Chemistry, Anderson's
 College Medical School, Dumbar-
 ton road. 1891
 a Watson, Thomas Lennox, I.A.,
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 850a Watson, William W., 5 Westbourne
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 a Weir, James, 72 St Andrew's drive,
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 855a Weir, William, Adamton, Monkton,
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 Wield, John, 9 Barns street, Ayr. 1895
 Williamson, John, 65 W. Regent st. 1881
 Wilson, Alex., Hyde Park Foundry,
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 860a Wilson, David, M.A., D.Sc., F.C.S.,
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 865 Wilson, Wm, F.E.I.S., School-
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 Wingate, Walter E., 1 King's Gate,
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 870 Wood, James, Dunard Street Public
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 Wood, James, M.A., Glasgow
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 a Wood, William James, 46 Queen's
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 S.G., Professor of Pathology, St
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 875 Wright, Robert Patrick, Professor
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 Agricultural College, 6 Blythswood
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 880 Young, Frank W., H.M. Inspector
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 a Young, John E., 24 Belhaven ter,
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